

SELECTED
WATER
RESOURCES
ABSTRACTS



VOLUME 5, NUMBER 4
FEBRUARY 15, 1972



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SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior



VOLUME 5, NUMBER 4
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W72-01691 -- W72-02252

UNITED STATES DEPARTMENT OF THE INTERIOR WATER SUPPLY

Water Supply Circular No. 10
Water Supply Circular No. 10
Water Supply Circular No. 10

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.



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FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by co-ordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the BioScience Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the

Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

SELECTED WATER RESOURCES ABSTRACTS

CONTENTS

FOREWORD

iii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

ISOTOP EFFECT ON THE THERMODYNAMIC ACTIVITY OF WATER,
Tennessee Univ., Knoxville. Dept. of Chemistry.
W. Alexander Van Hook.
Available from the National Technical Information Service as PB-204 892, \$3.00 in paper copy, \$0.95 in microfiche. Tennessee Water Resources Research Center, Knoxville, Report No 20, October 1971. 88 p, 7 fig, 21 tab, 98 ref. OWRR-A-012-Tenn (2).

Descriptors: Water structure, Ions, Solutes, *Thermodynamic properties, *Aqueous solutions, Heavy water, *Vapor pressure, *Enthalpy, *Free energy, Stable isotopes, Isotropy, *Entropy.
Identifiers: *Osmotic coefficients.

Vapor pressures of H₂O16 (ice and liquid), H₂O18 (ice and liquid), D₂O16 (ice and liquid), and of solutions of NaCl, KCl, LiCl, CsCl, NaBr, KF, CaCl₂, and Na₂SO₄ (Mostly from 0 to 100 deg C, and over wide concentration ranges) in H₂O and D₂O were determined in a new high precision apparatus. The data was thoroughly analyzed thermodynamically and equations and tables presenting the isotope effects on the excess free energies, enthalpies and entropies of solution and on the osmotic coefficients and the activity coefficients are presented at temperatures between 0 and 100 deg C, and to near saturation. The data are discussed in terms of models for aqueous solutions. W72-01695

THERMODYNAMIC PROPERTIES OF WATER TO 1,000C AND 10,000 BARS,
Pennsylvania State Univ., University Park.
C. W. Burnham, J. R. Holloway, and N. F. Davis.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$1.00. Office of Saline Water Research Development Progress Report No 414, March 1969, 90 p 6 tab, 3 ref. OSW 14-01-0001-408.

Descriptors: *Water properties, *Thermodynamic behavior, *Physical properties, Enthalpy, Entropy, Compressibility, Thermal expansion, Density.
Identifiers: PVT data, High temperature properties, Fugacity, Specific volume.

Measured values of the specific volume of water in the range 1,000 to 8,500 bars and 20 to 900C were fitted by high-order (8th and 9th degree) polynomials to obtain precise analytical expressions of the specific volume as a function of temperature and pressure. These expressions were integrated with respect to pressure, to obtain values of the Gibbs free energy of water, relative to those at 1,000 bars calculated from the data in the National Engineering Laboratory Steam Tables, 1964 (H.M. Stationery Office, Edinburgh). Similarly, entropies of water were obtained by differentiation of the volume expressions with respect to temperature, at constant pressure, followed by integration with respect to pressure and addition of the entropies at 1,000 bars from the same steam tables. The entropies were the combined with the Gibbs free energies to compute enthalpies. Fugacities of water also were calculated from the free-energy data. However, the reference pressure for fugacities was chosen as 0.01 bar instead of 1 bar because, at 1 bar and temperatures below approximately 200C, the fugacity coefficient departed markedly from unity. The final results of these calculations are embodied in tables of the thermodynamic properties of water covering the temperature range 20 to 1,000C, at intervals of 20C and the pressure range 1 to 10,000 bars, at intervals of 100 bars. (OSW abstract)
W72-02048

THE INFLUENCE OF MODEL MEMBRANE SYSTEMS ON THE STRUCTURE OF WATER,
North American Rockwell, Canoga Park, Calif.
For primary bibliographic entry see Field 03A.
W72-02109

SOLUTE PROPERTIES OF WATER-PART II,
Oklahoma Univ., Norman.
Sherrill D. Christian.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$0.45. Office of Saline Water, Research and Development Progress Report No. 706, July 1971. 35 p, 5 fig, 2 tab, 68 ref. OSW Grant 14-01-0001-1315.

Descriptors: *Water properties, *Solutes, *Solvation, *Thermodynamics, *Molecular structure.
Identifiers: Water complexes, Association equilibria.

Molecular complexes of water in organic solvents and in the vapor phase have been investigated using a variety of classical and spectral techniques. Thermodynamic constants for the formation of complexes between water and methanol and other polar molecules in different media have been reported and correlated with solvent effects on the individual donor and acceptor molecules. A method is presented for predicting the influence of the medium on energies and equilibrium constants for formation of complexes; progress toward the development of a general theory of the effect of solvents on molecular complex equilibria is described. (OSW abstract)
W72-02110

1B. Aqueous Solutions and Suspensions

ISOTOP EFFECT ON THE THERMODYNAMIC ACTIVITY OF WATER,
Tennessee Univ., Knoxville. Dept. of Chemistry.
For primary bibliographic entry see Field 01A.
W72-01695

THE INFLUENCE OF MODEL MEMBRANE SYSTEMS ON THE STRUCTURE OF WATER,
North American Rockwell, Canoga Park, Calif.
For primary bibliographic entry see Field 03A.
W72-02109

SOLUTE PROPERTIES OF WATER-PART II,
Oklahoma Univ., Norman.
For primary bibliographic entry see Field 01A.
W72-02110

02. WATER CYCLE

2A. General

HYDROLOGIC FACTORS IN THE DETERMINATION OF WATERSHED YIELDS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.

G. R. Higgins, and J. M. Colonell.

Available from the National Technical Information Service as PB-204 974, \$3.00 in paper copy, \$0.95 in microfiche. Massachusetts University Water Resources Research Center Publication No 20, July 1971. 125 p, 37 fig, 6 tab, 31 ref, 2 append. OWRR B-008-MASS (1).

Descriptors: *Watersheds (Basins), *Water yield, *Evaporation, *Reservoirs, *Massachusetts, Hydrology, Model studies, Computer models, Systems analysis, Input-output analysis, Streamflow, Rainfall-runoff relationships, Water temperature, Mass transfer, Hydrologic data, Energy budget.
Identifiers: *Quabbin Reservoir (Mass).

Hydrologic factors were examined concerning their role in the determination of watershed yields. The primary research effort was directed to the measurement of evaporation at Quabbin Reservoir in central Massachusetts. Application of conventional energy budget computations enabled the evaluation of the evaporative mass-transfer coefficient. Studies were also conducted on methods for determining the reservoir storage necessary to sustain safe yields under specified variable demands. The relatively new concept of the hydrologic response function was examined for its applicability to Massachusetts watersheds. The hydrologic response function should be capable of providing a ready source of information on generalized precipitation-runoff relationships and thus can be of considerable assistance in delineating areas of high and low flooding potential.
W72-01700

HYDROLOGIC CHARACTERIZATION OF FORESTED WATERSHEDS IN ARIZONA,
Arizona Univ., Tucson. Dept. of Watershed Management.

J. L. Thamnes, and R. M. Tinlin.

Available from the National Technical Information Service as PB-204 703, \$3.00 in paper copy, \$0.95 in microfiche. Partial Technical Completion Report, October 22, 1971. 22 p, 6 fig, 1 tab. OWRR-A-014-ARIZ (6).

Descriptors: *Hydrology, *Watershed management, *Forestry, *Analog models, *Arizona, Input-output analysis, Rainfall, Soil moisture, Analytical techniques, Integrated circuits, Electric currents, Simulation analysis.

The principal scheme and construction details of electrical analog circuit are described for modeling the hydrologic behavior of watersheds. The model employs passive electronic elements that modify an electrical input function in a manner markedly similar to the way rainfall input is modified by hydrologic parameters as it traverses through a watershed. It provides an excellent teaching and research tool for studying the major hydrologic processes of a watershed and their interrelationships. It is particularly suitable as a visual aid for familiarizing students with watershed behavior and can be used by researchers for developing functional relationships of hydrologic processes from electrical theory. (Woodard-USGS).
W72-01703

A CRITICAL REVIEW OF CURRENTLY AVAILABLE HYDROLOGIC MODELS FOR ANALYSIS OF URBAN STORMWATER RUNOFF,

Hydrocomp International Inc., Palo Alto. Calif.

Ray K. Linsley.

Available from National Technical Information Service as PB-204 815, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report, August 1971. 83 p, 11 fig, 3 tab, 96 ref. OWRR X-110 (No 3416) (1).

Descriptors: *Model studies, Evaluation, *Rainfall-runoff relationships, *Precipitation excess, *Soil moisture, *Runoff coefficient, California, Illinois.
Identifiers: *Rainfall intensity, Dry Creek (Calif), Echo Park (Calif), Boneyard Creek (Ill), *Flood frequency, *Urban hydrology, *Urban runoff.

The literature of hydrology is reviewed with respect to rainfall-runoff models. The requirements of urban hydrology and urban runoff models are defined. Existing models are described and their utility for urban applications evaluated. It is concluded that several well instrumented urban experimental watersheds are needed in order to test and possibly refine existing models. Specifications for such watersheds are presented.
W72-01978

ANALYSIS OF PERIODICITY IN HYDROLOGICAL SEQUENCES,
Karlova Universita, Prague (Czechoslovakia). Dept. of Mathematics and Statistics.

Field 02—WATER CYCLE

Group 2A—General

J. Andel, and J. Balek.

Journal of Hydrology, Vol 14, No 1, p 66-82, October 1971. 2 fig, 2 tab, 15 ref.

Descriptors: *Time series analysis, *Statistical methods, *Solar radiation, *Streamflow forecasting, Runoff forecasting, Stochastic processes, Mathematical studies, Climatology.

Identifiers: Hydrometeorological sequences.

A series of statistical tests are given as a basis for the objective analysis of a general hydrometeorological sequence and for the purpose of constructing a 'best fit' model. A further aim of the analysis was the identification of the composition of the sequence. Where the existence of one or more periodicities is indicated by tests at various levels of significance, these are integrated into the sequence simulation. Because the hydrological cycle is highly influenced by solar energy a similar influence of the sun can be expected on the time formation of hydrological phenomena. However, various combinations of this effect with other local either random or periodic effect produce time series varying from watershed to watershed. On the smaller watersheds the local influence may play a more important role, while the influence of the basic factors might be expected to prevail on the larger basins. Similarly the lag between sunspot periodicity and the complex hydrological periodicity cannot be expected to be equal for all sequences. Tests on 15 different rivers suggested the most frequently occurring periods to be 3.4, 4.3, 5.15, 7.3, 9.35, 11.95, 15.9, 22.6, 30.5 years. The existence of a periodicity in the sequence for the rivers Vah, Niger, and Nile was proven at the 5% level of significance while this level was almost attained for the Mississippi. (Knapp-USGS)

W72-02012

DETERMINATION OF NONLINEAR FUNCTIONAL RESPONSE FUNCTIONS IN RAINFALL-RUNOFF PROCESSES,
California Univ., Davis. Dept. of Water Science.
J. Amrocho, and A. Brandstetter.
Water Resources Research, Vol 7, No 5, p 1087-1101, October 1971. 7 fig, 1 tab, 9 ref. OWRR B-005-CAL (11). Calif WRC Grant W133.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Unit hydrographs, Input-output analysis, Hydraulic models, Simulation analysis, Streamflow forecasting, Systems analysis, Time series analysis, Distribution patterns, Synthetic hydrology.

The operation of some hydrologic systems can be represented by functional series expansions involving higher order nonlinear generalizations of the convolution integral, which underlies the unit hydrograph concept. A method was developed to determine the linear and nonlinear response functions of such systems on the basis of concurrent records of the input. This procedure was successfully tested in a special laboratory catchment and in a natural watershed to establish rainfall-runoff relations. (Knapp-USGS)

W72-02116

THE USE OF A REALISTIC RAINFALL SIMULATOR TO DETERMINE RELATIVE INFILTRATION RATES OF CONTRIBUTING WATERSHEDS TO THE LOWER GILA BELOW PAINTED ROCK DAM,
Arizona Univ., Tucson. Water Resources Research Center.

For primary bibliographic entry see Field 02G.
W72-02220

2B. Precipitation

YEAR-TO-YEAR VARIATIONS OF RAINFALL OVER THE INDIA-EQUATORIAL PACIFIC REGION AND OF LOW AND MIDDLE LATITUDE CIRCULATIONS IN THE SOUTHERN HEMISPHERE,
Meteorological Research Inst. Tokyo (Japan).

I. Tsuchiya.

Papers in Meteorology and Geophysics, Vol. 21, No. 2, p. 73-87, July 1970. 11 fig, 1 tab, 22 ref.

Descriptors: *Synoptic analysis, *Rainfall disposition, *Winds, *Variability, *Meteorological data, Arid lands, Monsoons, Air circulation, Tropical regions, Pacific Ocean.

Identifiers: *Anomalous rainfall distribution, *Walker Circulation, *India.

In general, the equatorial Pacific dry zone extends from the coast of Peru to 165 degrees West and within this zone rainfall averages less than 800 mm/yr. In very dry years such as 1955, 1956 and 1962, this zone extends to 165 degrees East and in very wet years such as 1957, 1958, 1965 and 1966, it disappears. An investigation of world precipitation and precipitation anomaly distribution maps revealed that in the years when there were anomalous rainfalls in the dry zone, there were unusually scanty rainfalls in the Indian-Indonesia region and vice-versa. An examination of rainfall records in the Indian-Indonesia islands in the dry zone and Indian weather records showed that these reverse rainfall variations between India and the equatorial Pacific have often occurred in the past. When these anomalous rainfall distributions occurred in 1957-1958 and 1965-1966, the southern westerlies were especially weak and probably influenced this phenomenon as did the southeast trades. The southern westerlies variations also play an important role in the weakening or strengthening of the Walker Circulation through the variations of sea-surface temperatures under the southeast trades. (Casey-Arizona)

W72-01741

CLIMATOLOGICAL INFLUENCES ON MOISTURE CHARACTERISTICS OF DEAD FUEL: THEORETICAL ANALYSIS,

Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
Michael A. Fosberg.

Forest Sci. 17 (1):64-72. Illus 1971.

Identifiers: Climatological, Dead, Fire, Forest, Fuel, Hazard, Moisture, Theoretical.

Numerical simulation of dead fuel behavior under different climatological regimes quantified 3 universal characteristics of fuel: response of the fuel to climatological moisture-induced stress; response of the outer layers of the fuel to both standard drying conditions and climatological stress; and time required for a fuel to become independent of its previous moisture history. The 1st 2 characteristics provide a basis for fuels classification. The 3rd allows evaluation of fuel moisture contributions to fire persistence and conditioning time for fuel moisture sensors. (Copyright 1971, Biological Abstracts, Inc.)

W72-01910

LYSIMETER AND INTERCEPTION STUDIES IN NARROW-LEAVED SNOW TUSSOCK GRASSLAND,

Department of Scientific and Industrial Research, Palmerston North (New Zealand). Plant Physiology Div.

Jennifer Rowley.

N Z J Bot. 8 (4): 478-493. Illus. 1970.

Identifiers: Balance, Blue, Burning, Chionochloa rigidia-M, Clipping, Grassland, Interception, Lysimeter, Narrow-leaved, New-Zealand, Poa colensoi-M, Snow, Tussock-M.

Non-weighting lysimeters were constructed to measure the net water balance of untreated, burnt, and clipped narrow-leaved snow tussocks (Chionochloa rigidia) and of a blue tussock (Poa colensoi) sward at 915 m on the Rock and Pillar Range, Central Otago. Lysimeters with untreated tussocks produced more water (66% of a yearly rainfall) than burnt tussocks (57%), producing in turn slightly more water than clipped tussocks (48%) or the blue tussock sward (45%). Interception was recorded from clipped and untreated snow tussocks mounted over rain gauges. Untreated tus-

ssocks on Mt. Cargill intercepted 4-6 times the precipitation recorded in standard gauges. The problems and limitations involved in measuring water balance using these lysimeters in this environment are discussed. (Copyright 1971, Biological Abstracts, Inc.)

W72-01931

DYNAMIC ORIENTATION OF MEDICAL CLIMATOLOGY,

Staatsliches Institut Rheuma und Baederwesen, Budapest, (Hungary).

I. Oernenyi.

Arch Phys Ther. 22 (2): 71-83. Illus. 1970.

Identifiers: Climatology, Dynamic, Human, Humidity, Medical, Orientation, Pressure, Temperature.

In European countries climate is also judged from a medical point of view. Thus various classifications of climatic categories based on measurable factors have been made. Experiments in climatic chambers have shown that barometric pressure, temperature, humidity, etc., can induce reactions in a diseased organism and that medical-meteorological forecasting can serve as a warning system. But these experiments have also shown that it is primarily the changes in weather which particularly affect humans. For this reason dynamic climatology which aside from traditional parameters also measures atmospheric ionization, atmospheric ozone content, atmospheric CO₂ content, atmospheric radiation, earth magnetism, the passage of frontal systems and other parameters is biologically more relevant than traditional static climatology. (Copyright 1971, Biological Abstracts, Inc.)

W72-01945

BIOMETEOROLOGICAL METHODS,

R. E. Munn.
Academic Press, New York, N.Y. 1970. 336p. Illus. Pr. \$6.95.

Identifiers: Bio, Book, Environmental, Meteorological, Methods.

This volume presents a unified look at methodology, citing examples of biometeorological studies. A brief survey of biometeorology is included; the remainder of the book places the various experimental, empirical, analytical and physical methods of biometeorology in perspective. Topics include: sampling the atmosphere, noting the time and space variables; design of biometeorological experiments; tables, graphs and charts; statistical and physical methods, synoptic applications; seasonal relationships, noting climatic classifications, indices and studies of past climates; and engineering applications. This volume should be of value to anyone seeking assistance in the design of experiments and analysis of environmental data. (Copyright 1971, Biological Abstracts, Inc.)

W72-01947

INVESTIGATION OF THE EFFECTS OF URBANIZATION ON PRECIPITATION TYPE, FREQUENCY, AREAL AND TEMPORAL DISTRIBUTION,

Rutgers-The State Univ., New Brunswick, N. J. Dept. of Meteorology.

Mark D. Shulman, and A. Roger Greenway.

Available from the National Technical Information Service as PB-204 866, \$3.00 in paper copy, \$0.95 in microfiche. New Jersey Water Resources Research Institute, New Brunswick, Completion Report, October 1971. 83 p, 26 fig, 9 tab, 27 ref, append. OWRR A-026-NJ (1).

Descriptors: *Environmental effects, *Precipitation (Atmospheric), Climatology, *Urbanization, New Jersey, New York, *Cities, *Climatic data. Identifiers: Precipitation trends, *Precipitation modification, *New York City (NY).

An investigation into the effects of urbanization on precipitation for the northern New Jersey-New

WATER CYCLE—Field 02
Precipitation—Group 2B

York Metropolitan area was undertaken. Analyses were performed on monthly precipitation data for a network of 20 urban and rural stations in New Jersey, New York and Connecticut from 1900 to 1970. Individual storm totals stratified according to wind direction at the surface and 850 mb were analyzed for a network of 91 stations from 1951 through 1969. Results indicate that precipitation variability and total amounts were greater in surrounding areas than in the central urban complex and that these differences are due primarily to summer precipitation. It was found that during periods of drought, precipitation differences between urban and rural areas are minimized while homogeneity increases. In addition, homogeneity of precipitation variability was a function of distance from New York City. During the period of study 14 out of 20 stations tested for trends showed decreasing annual precipitation totals with time. Analysis of variance indicates a tendency for increased precipitation downwind of the center city with northeast and southwest winds both at the surface and aloft, while with northeast surface winds and southwest or southeast winds aloft a more complicated pattern occurs.

W72-01982

THE GENESIS OF SUDDEN STRATOSPHERIC WARMINGS AND THE QUASI-BIENNIAL CYCLES,
National Aeronautics and Space Administration, Huntsville, Ala. Marshall Space Flight Center.

J. W. Smith.

Available from the National Technical Information Service, Springfield, Va. as NASA-TN-D-6522, \$3.00 paper copy, \$0.95 in microfiche. National Aeronautics and Space Administration Technical Note NASA TN D-6522, October 1971. 23 p, 10 fig, 22 ref.

Descriptors: *Climatology, *Weather, *Temperature, *Weather patterns, *Weather forecasting, Hydrologic cycle, Reviews, Precipitation (Atmospheric).
Identifiers: *Stratospheric warmings, *Quasi-biennial cycles.

A mechanism believed to be responsible for sudden stratospheric warmings, as well as biennial cycles in temperature, wind, ozone, pressure, precipitation, and the January thaw, is discussed. These biennial cycles are caused by hemispheric exchanges of air in the stratosphere. The hemispheric exchanges are caused by unequal heating of the hemispheres because of the ellipticity of the earth's orbit. The resulting annual atmospheric surges are minimized or omitted during the 11-year sunspot minima, resulting in long-term mean cycles of about 26.4 months. (Woodard-USGS)
W72-02023

CLIMATE OF THE ELK RIVER BASIN AND CLIMATOLOGICAL SUMMARIES FOR PICKENS, WEBSTER SPRINGS, AND GASAWAY, WEST VIRGINIA,
West Virginia Univ., Morgantown.

R. O. Weedin, W. H. Dickerson, M. S. Baloch, and E. N. Henry.

Available from the National Technical Information Service, Springfield, Va. 22151, as COM-71-00779, \$3.00 paper copy, \$0.95 in microfiche. Water Research Institute Appalachian Center, West Virginia University Information Report 5, 1971. 16 p, 5 fig, 10 tab (NOAA Report No 71061820). 5201108/11H301.

Descriptors: *Hydrologic data, *Climatology, *Meteoro logical data, *Data collections, *West Virginia, Precipitation (Atmospheric), Temperature, Humidity, River basins, Reviews.
Identifiers: *Elk River basin (W.Va.).

Precipitation, temperature, and relative humidity records are summarized for various cities in the Elk River basin of West Virginia. The average width of the basin is 20 miles and its length 90 miles. The river, following a 181-mile course through the

basin, drains approximately 1,532 square miles or 980,480 acres. Kanawha and Webster Counties contain nearly 80 percent of the land in the watershed. The climate of the Elk River basin may be termed humid continental; humid because of its copious, evenly distributed precipitation, and continental because of its large yearly temperature range. The eastern third of the Elk River basin, and particularly the easternmost part in Pocahontas County, has a cooler mountain-type climate because of the higher elevations. Topographical features of the area cause large variations in climate between the headwaters and the mouth of the Elk River basin, which are at about the same latitude. (Woodard-USGS)
W72-02025

ESTIMATED RETURN PERIODS FOR SHORT-DURATION PRECIPITATION IN UTAH.
National Oceanic and Atmospheric Administration, Salt Lake City, Utah. National Weather Service.

E. A. Richardson.

Available from the National Technical Information Service, Springfield, Va. 22151, as COM-71-00781, \$3.00 paper copy, \$0.95 in microfiche. Utah State University Dept of Soils and Biometeorology Bulletin No 1, March 1971. 68 p, 1 fig, 3 ref, append. (NOAA Report No 71042808). 5204103/11H301.

Descriptors: *Precipitation (Atmospheric), *Meteorological data, *Hydrologic data, *Frequency analysis, *Utah, Distribution patterns, Time series analysis, Systems analysis, Computer programs, Forecasting, Precipitation gages, Data collections. Identifiers: *Precipitation return periods (Utah), Statistical analysis.

Tables are presented which can be used to calculate the probability of precipitation amount and duration for return periods of 1 to 100 years and for durations of 5 minutes to 24 hours in Utah. Architects use this data in roof design, irrigation engineers need this information when designing irrigation systems on farms and ranches, and soil conservation districts must consider the impact of heavy storms on their operating plans. In urban areas, the design capacity of storm sewers is based on calculations of the maximum runoff from streets, lawns and parking lots. In fact, the design of many projects is directly influenced by the potential maximum rate of fall of precipitation or the potential maximum volume of runoff. (Woodard-USGS)
W72-02026

SNOW IN OHIO,
Ohio Agricultural Research and Development Center, Wooster.
For primary bibliographic entry see Field 02C.
W72-02027

OUTLINE OF A BAYESIAN APPROACH TO THE EML MULTIPLE CLOUD SEEDING EXPERIMENTS,
National Oceanic and Atmospheric Administration, Boulder, Colo. Experimental Meteorology Lab.

For primary bibliographic entry see Field 03B.
W72-02058

COMPLEXES OF SILVER IODIDE AND SECONDARY AMINES,
Naval Weapons Center, China Lake, Calif.
For primary bibliographic entry see Field 03B.
W72-02072

CHARACTERISTICS OF ATMOSPHERIC PRECIPITATION IN THE SOUTHEASTERN PART OF THE WEST SIBERIAN PLAIN (NEKOTORYYE OSOBNOSTI ATMOSFERNOGO UVLAZHENIYA NA YUGO-VOSTOKE ZAPADNO-SIBIRSKOY RAVNINY),
Novosibirsk Pedagogical Inst. (USSR).

A. P. Slyadnev.

In: Kompleksnoye osvoyeniye vodnykh resursov Okskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 99-110, 1970. 8 fig, 2 tab, 23 ref.

Descriptors: *Precipitation (Atmospheric), *Hydrologic cycle, *Water balance, *Heat balance, Meteorology, Climatology, Climatic data, Seasonal, Droughts, Plant growth, Crop production, Wheat.

Identifiers: *USSR, *West Siberia, West Siberian Plain, Correlation coefficient.

Agrometeorological conditions for obtaining a high yield of summer crops depend upon a combination of several cycles of climatic fluctuation with a periodicity of 11, 16, 32, or more years. The 32- and 16-year changes in hydrothermal conditions in May and June are a reflection of corresponding cycles in a recurrence of a zonal or meridional transfer of air masses. If the year 1966 is taken as the beginning of a new moisture cycle, the next 15-18 years will be characterized by an ascending phase, when agroclimatic conditions in May and June will be more favorable for the growth of summer crops. The ascending phase will reach a maximum by 1982. The relationship between an 11-year solar cycle and a change in climate was observed for various regions of the world. In the southeastern part of the West Siberian Plain an 11-year cycle is reflected in an alternation of periods of favorable and unfavorable hydrothermal regimes for yields of spring wheat. The beginning of the cycle relates to the beginning of a 10-year period and is expressed by droughts in May and June. In the second half of the 10-year period droughts are less common. The rate of development of the properties of an 11-year cycle increases in the descending phase of a 32-year moisture cycle. In the ascending phase, which began in 1966, the phenomena of an 11-year cycle are less probable. (Josefson-USGS)
W72-02100

PRECIPITATION PROBABILITIES AS INDICES OF CLIMATIC VARIATION OVER THE EASTERN UNITED STATES,

Western Michigan Univ., Kalamazoo; and National Oceanic and Atmospheric Administration, Detroit, Mich.

V. L. Eichenlaub, N. D. Strommen, and D. G. Dickason.

Professional Geographer, Vol 23, No 4, p 301-307, October 1971. 5 fig, 1 tab, 7 ref.

Descriptors: *Precipitation (Atmospheric), *Probability, *Statistical methods, *Mapping, *Variability, Probable maximum precipitation, Theoretical analysis, Environmental effects, Meteorological data, Synoptic analysis, Geographical regions. Identifiers: *Gamma probability functions.

Because precipitation data have a lower bound of zero, they are not normally distributed, and the arithmetic mean is a biased measure of central tendency. For this reason, precipitation probability values were derived from the gamma probability function. Such probabilities were calculated for 23 states in the eastern U.S., utilizing monthly divisional precipitation averages for the period 1931-1965. The primary purpose was to indicate the usefulness of mapping the shape parameter, gamma, as an aid in depicting regional precipitation characteristics which may be masked when more conventional statistics are employed. In using averaged divisional data, much of the randomness of individual station data has been suppressed, thus giving additional validity to interpretation of the probability values. Maps of January and July gamma parameters are presented in illustration of the utility of the mapping technique and indicate the importance of lake effects, seabreeze convergence, coastline geography, orographic effects and proximity to storm paths in affecting monthly precipitation probabilities. Additionally, the classic Tennessee rainfall area was reexamined, and consequently significantly reduced in both size and intensity. (Casey-Arizona)

Field 02—WATER CYCLE

Group 2B—Precipitation

W72-02210

SOME REGIONAL DIFFERENCES IN RUNOFF-PRODUCING THUNDERSTORM RAINFALL IN THE SOUTHWEST, Southwest Watershed Research Center, Tucson, Ariz. H. B. Osborn.

Descriptors: *Thunderstorms, *Rainfall, *Rain gages, *Storm structure, *Southwest U.S., Arizona, New Mexico, Arid lands, Climatic data, Air masses, Convection, Rainfall disposition, Rainfall intensity, Depth-area-duration analysis, Distribution patterns.
Identifiers: *Recording rain gages.

Quantitative descriptions of regional differences of rainfall amounts and intensities in the southwest, such as depth-duration frequencies, generally have ignored differences in the storm system that generated the rainfall and have lumped essentially different storm systems together. Thunderstorm rainfall in southern Arizona and New Mexico were analyzed using data from both recording and standard rain gages. The results were somewhat conflicting. Possibly because of more frontal activity and less distance from the Gulf of Mexico, the thunderstorms in eastern New Mexico can be more intense than those in southeastern Arizona. Recording rain gage records suggest that air-mass thunderstorms produce a larger number of more intense short-duration (about 1 hour or less) rains in southeastern Arizona than in other parts of southern Arizona. However, standard rain gage records from southern Arizona indicate that rainfall from individual air-mass thunderstorms may be greater in south-central Arizona than in SE or SW Arizona. But frequency analysis of standard gage data from air-mass storms shows that the 100-year point rainfall is about 3 inches in all 3 regions. With more data becoming available, especially from remote areas, more exact separation of thunderstorm types and a better definition of rainfall will soon be possible. (See also W72-02212) (Casey-Arizona)
W72-02214

2C. Snow, Ice, and Frost

HYDROLOGIC CHARACTERIZATION OF FORESTED WATERSHEDS IN ARIZONA, Arizona Univ., Tucson.

D. B. Thorud, and P. F. Ffolliott.
Available from the National Technical Information Service as PB-204 646, \$3.00 in paper copy, \$0.95 in microfiche. Partial Completion Report, October 1971. 5 p, 5 ref. OWRR-A-014-ARIZ (4).

Descriptors: *Snowmelt, *Ponderosa pine trees, *Forestry, *Melt water, *Arizona, Forest management, Water balance, Hydrologic budget, Runoff, Mathematical studies, Equations, Forecasting, Watershed management.

Inventory-prediction equations describing snowpack accumulations as functions of readily available or easily obtained measurements of forest density and land form were developed for use in Arizona ponderosa pine. To obtain data for the equations, measurements of the snowpack water equivalent were made with a Federal snow tube and scale at sample points to characterize (1) a winter accumulation-melt period, and (2) the peak accumulation, prior to spring runoff. Measurements of forest density were made at the same sample points and included basal area, sum of diameters, number of trees, bole area, and wood volume. Although empirical, the developed prediction equations included forest density measurements assumed to index the interception of input precipitation, obstruction of direct beam solar radiation, and radiation emission from trees onto the snowpack. Measurements of land form factors were included in the equations to index the quantity of direct beam solar radiation. These inventory-prediction equations should help land managers design

forest management systems that will maximize the snowpack water equivalent at peak accumulation within constraints dictated by other management objectives such as timber production. (Woodard-USGS).

W72-01702

ON THE TEMPERATURE PROFILE AND THE AGE PROFILE IN THE CENTRAL PART OF COLD ICE SHEETS, Swiss Federal Inst. for Snow and Avalanche Research, Davos-Weisefluehjoch.

K. Philibert, and B. Federer.

Journal of Glaciology, Vol 10, No 58, p 3-14, 1971. 2 fig, 2 tab, 19 ref, 2 append.

Descriptors: *Glaciers, *Movement, *Rheology, Flow, Melting, Regimen, Slopes, Temperature, Ice, Shear stress, Strain, Stress.
Identifiers: Ice sheets.

The generalized Glen's law is used to calculate the horizontal and vertical velocity profiles and from these the temperature and age profiles of cold ice sheets. It is shown that, by using a pressure-melting function increasing linearly the height, velocity profiles for all ice sheets are obtained which represent excellent approximations to the true ones, since, above a critical height where the deviation from linearity becomes large, the influence of temperature on ice flow becomes negligible. In a comparison of the present theory with Robin's treatment a larger temperature difference of up to 30% is obtained. Furthermore the present theory yields an age considerably increased compared with Nye's model. (Knapp-USGS)
W72-01705

PERMEABILITY, BRINE CONTENT AND TEMPERATURE OF TEMPERATE ICE, Centre National de la Recherche Scientifique, Grenoble (France). Laboratoire de Glaciologie. L. Lliboury.

Journal of Glaciology, Vol 10, No 58, p 15-29, 1971. 2 fig, 41 ref.

Descriptors: *Glaciers, *Permeability, *Movement, *Flow, *Salinity, Porosity, Freezing, Melting, Rheology, Crystallization, Temperature, Mass transfer, Water chemistry.
Identifiers: Temperate glaciers.

Temperate glaciers contain liquid inclusions in which the concentration of salts is not too high. Nevertheless these salts produce a depression in temperature comparable with that due to the pressure, and much greater than that due to interfacial energies. Because of this a large part of the liquid water present in the ice is not mobile. Deformation and recrystallization is bound to close off capillary intergranular channels, for glacier ice is usually impermeable. Firn, at a depth which the annual cold wave does not reach, is nevertheless transformed relatively suddenly into physically impermeable ice. Saline inclusions migrate with a velocity inversely proportional to the potential temperature (difference from the melting point of pure ice at the pressure in question) and proportional to the gradient of this potential temperature. This velocity, the salinity, the liquid water content, and the ice temperature parameters which are all functions of the depth, may be calculated for a steady state in a stagnant or moving glacier. Under the action of anisotropic stresses, isolated conclusions perpendicular to the maximum compressive stress enlarge at the expense of their neighbors. If however two inclusions are connected by a capillary channel, no enlargement occurs, but instead the salt content decreases, evacuated to the other inclusion. This process constitutes an objection to the theory of glacier sliding by melting and refreezing around small obstacles, unless new subglacial mechanisms are proposed. (Knapp-USGS)
W72-01708

SHEAR STRESS AT THE BASE OF A RIGIDLY CIRQUE GLACIER, Northwestern Univ., Evanston, Ill. Materials Research Center.

J. Weertman.

Journal of Glaciology, Vol 10, No 58, p 31-37, 3 fig, 1 tab, 15 ref.

Descriptors: *Glaciers, *Movement, *Shear stress, Mathematical studies, Slopes, Stress, Strain, Cirques, Flow.
Identifiers: Cirque glaciers.

The value of the basal shear stress is derived for two-dimensional and three-dimensional cirque glaciers. It is assumed that a cirque glacier moves primarily by a rigid-body rotation over a bed of cylindrical or spherical shape. In the region of maximum ice thickness the new value of the basal shear stress is only about one half that derived from equations in common use in the literature. (Knapp-USGS)
W72-01707

FLOW IN A TRANSVERSE SECTION OF ATHABASCA GLACIER, ALBERTA, CANADA, California Inst. of Tech., Pasadena. Div. of Geological Sciences.

C. F. Raymond.

Journal of Glaciology, Vol 10, No 58, p 55-84, 1971. 16 fig, 3 tab, 30 ref.

Descriptors: *Glaciers, *Flow, *Surveys, Movement, Rheology, Profiles, Velocity, Strain, Stress, Regimen, Ablation, Boreholes, Instrumentation.
Identifiers: Athabasca Glacier (Canada).

Measurements of ice deformation were made at the surface and at depth in the Athabasca Glacier, Canada, to reveal the pattern of flow in a nearly complete cross-section. Tilting in nine boreholes was measured with a newly developed electrical inclinometer. Basal sliding velocity exceeds 70% of the surface velocity over half of the width of the glacier. Marginal sliding velocity is much less than basal sliding velocity at the center-line (about 40 m per yr). Marginal shear strain-rate near the valley walls is two to three times larger than the basal shear strain-rate near the center-line (0.1 per yr). The observed longitudinal flow is significantly different from that expected from theoretical analysis of flow in cylindrical channels. These differences are caused to a large extent by the contrast between the actual distribution of sliding velocity and the constant sliding velocity for which the theoretical analysis holds. The observed relation between marginal and basal sliding velocity is probably a general flow feature in valley glaciers, and may be caused by lateral variation of water pressure at the ice-rock contact. Longitudinal strain-rate decreases with depth, becoming nearly 0 at the bed in the center of the glacier. Motion transverse to the longitudinal flow occurs in a roughly symmetric pattern of diverging marginward flow, with most of the lateral transport occurring a depth. The observed lateral velocities averaged over depth are compatible with lateral flow required to maintain portions of the glacier surface under ablation, and are driven by the convex lateral profile of the ice surface. (Knapp-USGS)
W72-01708

THE POSSIBLE FUTURE BEHAVIOUR OF BERENDON GLACIER, CANADA - A FURTHER STUDY,

Department of Energy, Mines and Resources, Ottawa (Ontario).

D. A. Fisher, and S. J. Jones.

Journal of Glaciology, Vol 10, No 58, p 85-92, 1971. 3 fig, 2 tab, 19 ref.

Descriptors: *Glaciers, *Movement, *Regimen, Water balance, Hazards, Flow, Data collections, Ablation, Snowfall.
Identifiers: Berendon Glacier (Canada), Mass balance (Glaciers).

WATER CYCLE—Field 02

Snow, Ice, and Frost—Group 2C

Forecasts of future movement of Berendon Glacier, B. C. were repeated using much improved data and a slightly different method for computing the datum state. The predictions that result are very similar to those found earlier. The chance of the glacier rising sufficiently in the next 25 years to be a danger to the mining installations situated near the snout of the glacier is much greater than was previously considered. The theory is shown to be most sensitive to changes in the velocity figures used. Detailed knowledge of mass balance is not necessary to set up the datum state, although the mean mass balance is needed to compare with the final prediction. (Knapp-USGS).
W72-01709

BASEMENT ICE, WARD HUNT ICE SHELF, ELLESMORE ISLAND, CANADA.
Dartmouth Coll., Hanover, N. H. Dept. of Earth Sciences.
J. B. Lyons, S. M. Savin, and A. J. Tamburi.
Journal of Glaciology, Vol 10, No 58, p 93-100, 1971. 3 fig, 1 tab, 21 ref.

Descriptors: *Sea ice, *Freezing, *Provenance, Stable isotopes, Salinity, Crystallography, Cryology, Ice, Arctic, Tritium, Tracers, Melt water, Melting.
Identifiers: Ellesmere Island (Canada), Ward Hunt Ice Shelf.

The basement ice of the Ward Hunt Ice Shelf is largely composed of a unique brackish ice, which interdigitates with sea ice. Some iced firm occurs near the top of the basement ice, below an unconformity. Stratification in brackish and sea ice represents annual increments to the bottom of the ice shelf. The c-axis vertical orientation and small-angle grain-boundary relations in brackish ice are explained by nucleation and floating of ice dendrites from the undercooled brackish water zone to the bottom of the ice shelf, where they attach themselves sub-parallel to the plane of the undersurface. Ice island T-3 did not come from a breakup of the main part of the Ward Hunt Ice Shelf but probably originated in a nearby area to the west. (Knapp-USGS).
W72-01710

ALBEDO OF MELTING SEA ICE IN THE SOUTHERN BEAUFORT SEA,
McGill Univ., Montreal (Quebec). Dept. of Physics; McGill Univ., Montreal (Quebec). Ice Research Project.
M. P. Langenberg.
Journal of Glaciology, Vol 10, No 58, p 101-104, 1971. 1 fig, 1 tab, 2 ref.

Descriptors: *Albedo, *Sea ice, *Arctic, Melting, Melt water, Solar radiation, Mapping, Data collections, Ice, Snow, Surveys.

Albedo values during the melt season on sea ice north of Tuktoyaktuk, Canada, were significantly higher than for the ice cover in Tanquary Fiord at similar stages of melting. The albedo decreased linearly with increasing puddling, and its rate of decrease was near the value of 0.30 for Tanquary Fiord. The data for the Beaufort Sea, extrapolated to conditions that prevail before the start of melting and at the other extreme to a fully flooded ice cover, yield values of the albedo of 0.59 and 0.27 respectively. The differences in the albedo of ice in the Beaufort Sea and in Tanquary Fiord were caused by different amounts of surface contamination. In Tanquary Fiord, the distance to the nearest shore from any point was less than three kilometers. The ice therefore was more likely to become sprinkled with windblown dust from shore than it was in the Beaufort Sea areas, which were tens of kilometers offshore. (Knapp-USGS).
W72-01711

PERMAFROST OCCURRENCE IN THE FRONT RANGE, COLORADO ROCKY MOUNTAINS, U.S.A.,

Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.
J. D. Ives, and B. D. Fahey.

Journal of Glaciology, Vol 10, No 58, p 105-111, 1971. 3 fig, 1 tab, 31 ref.

Descriptors: *Permafrost, *Alpine, *Colorado, Rocky Mountain Region, Temperature, Climates, Altitude, Mountains, Frozen ground, Frozen soils, Tundra.

Identifiers: Alpine permafrost.

Above tree line (about 3,500 m) in the Front Range of Colorado, scattered patches of permafrost begin to occur under wet sites blown free of snow in winter with a mean annual air temperature of about -1.0 degrees C. At greater elevations, with correspondingly lower mean annual air temperatures (extreme case -9.0 degrees C and 4,400 m), permafrost becomes more extensive and probably exceeds 60 m in thickness. These initial results are derived from ground-temperature observations supplemented by indirect evidence and by data gathered from engineering and mining operations. It is probable that under the higher summits and ridge crests exists an alpine equivalent of the continuous zone of Arctic permafrost. (Knapp-USGS).
W72-01712

EVIDENCE OF CIRQUE GLACIATION IN THE FALKLAND ISLANDS,

Aberdeen Univ. (Scotland). Dept. of Geography.
For primary bibliographic entry see Field 02.

W72-01713

A HOT-WIRE ENGINE TO PRODUCE PERIODIC GROOVES ON AN ICE SURFACE,

Cold Regions Research and Engineering Lab., Hanover, N. H.

T. M. Tobin, and K. Itagaki.
Journal of Glaciology, Vol 10, No 58, p 139-142, 1971. 2 fig, 8 ref.

Descriptors: *Diffusion, *Ice, *Crystallography, *Instrumentation, *Cryology, Equipment, Melting.

Identifiers: Self-diffusion.

A strain-free grooving method was developed for preparation of samples for surface self-diffusion studies of ice. This method utilizes a hot-wire grooving engine and is capable of obtaining a uniform spacing between grooves ranging from 15.9 micrometers to 159 micrometers in increments of 15.9 micrometers. (Knapp-USGS).
W72-01714

CORRECTIVE TERMS IN THE GLACIOLOGICAL BALANCE,

Centre National de la Recherche Scientifique, Grenoble (France). Laboratoire de Glaciologie. L. Lliboutry.

Journal of Glaciology, Vol 10, No 58, p 148-150, 1971. 1 fig, 1 ref.

Descriptors: *Calibrations, *Discharge (Water), *Water balance, *Regimes, *Glaciers, Ablation, Mathematical studies, Movement.

Identifiers: *Mass balance (Glaciers).

Two corrective terms are given for calculating the mass balance of glaciers between two cross-sections. The first results from the fact that balances are measured at moving stakes. The second correction arises because the discharges are calculated through summer cross-sections which are smaller than their mean values during the whole year. (Knapp-USGS).
W72-01715

RADIOECOLOGICAL INVESTIGATIONS OF PLUTONIUM IN AN ARCTIC MARINE ENVIRONMENT,

Danish Atomic Energy Commission, Risoe. Research Establishment.

For primary bibliographic entry see Field 05B.
W72-01884

THE SURFACE DRIFT OF A STREAM IN LAPLAND, (IN GERMAN),

Eberhard Thomas.

Oikos. Suppl. (13): 45-64. Illus. 1970. English summary.

Identifiers: Diptera, Drift, Ephemeroptera, Lapland, Plecoptera, Stream, Surface, Trichoptera.

The surface drift of a stream near Messaure (66 degrees 32 minutes N, 20 degrees 25 minutes E) was sampled from the break-up of ice in May until ice-cover in Sept. Samples were automatically taken at 2h-intervals. The diel pattern of hatching, egg-laying, flight activity and larval ecdysis was examined for a number of Ephemeroptera, Plecoptera, Trichoptera and Diptera Chironomidae. Invariably these events were taking place in a diel pattern which frequently differed even between closely related species.—Copyright 1971, Biological Abstracts, Inc.
W72-01943

REFRACTION SEISMIC INVESTIGATION AT ZEMU GLACIER, SIKKIM,

Geological Survey of India, Lucknow.

R. N. Bose, N. P. Dutta, and S. M. Lahiri.
Journal of Glaciology, Vol 10, No 58, p 113-119, 1971. 9 fig, 1 tab, 3 ref.

Descriptors: *Glaciers, *Ice, *Sounding, *Seismic studies, Surveys, Topography, Regimen, Ablation, Glacial drift, Erosion, Sedimentation.

Identifiers: Zemu Glacier (Sikkim).

In the Zemu Glacier in Sikkim, the thickness of the ice ranges from about 125 m at the edge of the glacier to about 300 m at the center. The bedrock section across the glacial valley as drawn on the basis of seismic data, shows that the glacier has undergone considerable lateral shrinkage. The seismic velocity in the glacier ice, which ranges between 3,500 m/s and 3,700 m/s, is in good agreement with the values obtained on glaciers in various parts of the world. (Knapp-USGS).
W72-02000

A NEW BORE-HOLE INCLINOMETER,

California Inst. of Tech., Pasadena.

C. F. Raymond.
Journal of Glaciology, Vol 10, No 58, p 127-132, 1971. 3 fig, 4 ref. Grant No. NSF - 5447.

Descriptors: *Borehole geophysics, *Instrumentation, *Drilling, *Subsurface investigations, Logging (Recording).

Identifiers: *Borehole inclinometers.

A newly developed borehole inclinometer permits the determination of borehole configurations with greater accuracy and efficiency in comparison with earlier systems of inclinometry. Instrument orientation is given to within 0.1 deg in magnitude of tilt and 10 deg in azimuth of tilt by an electrical output which can be read remotely from the surface. (Knapp-USGS).
W72-02001

AN IMPROVED METHOD FOR DETERMINING ICE FABRICS,

Wisconsin Univ., Milwaukee. Dept. of Geological Sciences.

J. R. Hill, and N. P. Lasca.

Journal of Glaciology, Vol 10, No 58, p 133-138, 1971. 6 fig, 2 ref.

Descriptors: *Crystallography, *Ice, *Petrofabrics, *Glaciers, *Microscopy, Instrumentation, Petrography, Cryology.

Field 02—WATER CYCLE

Group 2C—Snow, Ice, and Frost

Identifiers: *Ice fabrics.

In ice-fabric studies, use of an accessory plate is necessary in conjunction with the Rigsby universal stage to discriminate between the a- and c-axes of an ice crystal when the orientation of the c-axis is parallel or nearly parallel to the stage. Techniques are described to permit orientation of the c-axis regardless of its original orientation. (Knapp-USGS) W72-02020

DETECTION OF THAWING SNOW AND ICE PACKS THROUGH THE COMBINED USE OF VISIBLE AND NEAR-INFRARED MEASUREMENTS FROM EARTH SATELLITES,
National Environmental Satellite Service, Washington, D. C.
For primary bibliographic entry see Field 07B. W72-02016

SNOW IN OHIO,
Ohio Agricultural Research and Development Center, Wooster.

M. E. Miller, and C. R. Weaver.

Available from the National Technical Information Service, Springfield, Va., 22151, as COM-71-00773, \$3.00 in paper copy, \$0.95 in microfiche. Ohio Agricultural Research and Development Center Research Bulletin 1044, April 1971. 23 p, 5 fig, 8 tab, 15 ref. (NOAA Report No 71061814). 5201105/1IH301200.

Descriptors: *Snow, *Snowfall, *Hydrologic data, *Data collections, *Ohio, Climatology, Precipitation gages, Lake Erie, Weather patterns, Snow surveys.

Identifiers: *Snowfall records (Ohio).

Using snowfall records available for Ohio, this report provides information on mean monthly and annual snowfall amounts; frequency of selected snowfalls; threshold dates of first 1-, 3-, and 4-inch snowfalls of the winter season; duration of snow cover; extreme snowfalls and snow depths; and some notable snowstorms or unusually snowy winters. The heaviest snowfall in Ohio occurs near Chardon in the heart of Ohio's snowbelt where a total of 106.1 inches is normal and 161.5 inches fell during the winter of 1959-1960. The southernmost counties near the Ohio River receive an average of 13 to 17 inches of snow each winter. It is not a rare occurrence, however, for southern Ohio to receive more snowfall from an individual snowstorm than central or northern areas. (Woodard-USGS) W72-02027

PERMAFROST-HYDROGEOLOGIC REGIMEN IN TWO ICE-FREE VALLEYS, ANTARCTICA, FROM ELECTRICAL DEPTH SOUNDING,
Northern Illinois Univ., DeKalb. Dept. of Geology.

L. D. McGinnis, and T. E. Jensen.

Quaternary Research, Vol 1, No 3, p 389-409, September 1971. 10 fig, 5 tab, 28 ref. NSF Grant GA1710.

Descriptors: *Lakes, *Permafrost, *Water chemistry, *Surface-groundwater relationships, *Antarctic, Salinity, Sounding, Surveys, Electrical studies, Frozen ground, Groundwater movement, Brines, Hydrogeology.

Identifiers: Antarctica, Ice-free valleys.

Confining permafrost thicknesses, as determined by electrical depth soundings, vary considerably throughout two ice-free valleys in Antarctica. In general, several meters of confining permafrost are found near the surface in the valley bottoms. This prevents any exchange of water between the surface and subsurface; however, at some localities confining permafrost is absent and groundwater discharges. At some of these sites evaporite salts are accumulating. Thick occurrences of confining permafrost were found beneath Taylor Glacier, east of Lake Vanda, inland from the Ross Sea, and in Wright Valley. Where such thicknesses are not found, a combination of anomalous thermal events may have altered the regional permafrost

character. High salt concentrations in the subsurface lower the freezing point of groundwater and allow groundwater movement at greatly lowered temperatures. The presence of saline water in the lakes of the ice-free valleys may be in part due to the lateral movement of groundwater from beneath the continental ice sheet. (Knapp-USGS) W72-02030

TEMPERATURE AND CONDUCTIVITY MEASUREMENTS UNDER ICE ISLAND T-3,
Oregon State Univ., Corvallis. Dept. of Oceanography.
For primary bibliographic entry see Field 02K. W72-02042

TWO INVESTIGATIONS OF RIVER ICE: PART I AND PART 2,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.

G. D. Ashton, M. S. Uzuner, and J. F. Kennedy.
Available from National Technical Information Service, Springfield, Va. 22151, as AD-728 114 for \$3.00 in paper copy. Iowa Institute of Hydraulic Research Report No 129, October 1970. 44 p, 23 fig, 2 tab, 9 ref. USAEC Contract DACW25-69-C-0098.

Descriptors: *Ice loads, *Rivers, *Ice breakup, *Streamflow, Investigations, Data collections, Hydrologic data, Analytical techniques, Instrumentation, Temperature, Velocity, Melting.

Vertical and lateral temperature and velocity distributions, and ice thickness and configuration were measured in an Iowa river at frequent intervals during a period of ice cover. The undersurface of the ice remained plane as the ice thickened, and became wavy as the ice melted. The shear velocity associated with the wave forms was determined. Just prior to breakup, the ice became very porous in the lower portions of the ice cover. The diurnal temperature variation prior to the formation of an ice cover are described. Laboratory investigations included studies to determine the critical velocity at which a broken ice cover becomes unstable, an investigation of the reformation of ice after passage of an ice breaker, and the characteristics of ice during formation. The effect of a channel on the rate of thickening of the ice cover was determined. Ice experiments were conducted using the Iowa low temperature flow facility. Supplemental experiments using simulated ice were also conducted in a glass-walled tilting flume. (Woodard-USGS) W72-02056

FORMATION OF SPRING RUNOFF IN THE VASYUGAN'YE (O FORMIROVANI VESENNEGO STOKA V USLOVIYAKH VASYUGAN'YE),
Tomsk State Univ. (USSR).

For primary bibliographic entry see Field 04A. W72-02068

COMPLEXES OF SILVER IODIDE AND SECONDARY AMINES,
Naval Weapons Center, China Lake, Calif.

For primary bibliographic entry see Field 03B. W72-02072

CREEP OF ICE UNDER LOW STRESS,
Cold Regions Research and Engineering Lab., Hanover, N.H.

M. Mellor, and R. Testa.
Journal of Glaciology, Vol 10, No 52, p 147-152, February 1969. 4 fig, 1 tab, 5 ref.

Descriptors: *Rheology, *Creep, *Ice, *Deformation, *Cryology, Temperature, Pressure, Plastic deformation, Plasticity, Stress, Strain, Movement, Glaciers, Crystallography, Strength of materials.

Identifiers: *Strain rate.

Uniaxial compressive creep tests on fine-grained polycrystalline ice indicate that secondary strain-

rate is proportional to the 1.8 power of applied stress, for the range 0.1 to 0.5 kg/sq cm. On the basis of the present tests, earlier results suggesting linear viscous behavior at low stress are believed to be invalid. (Knapp-USGS) W72-02091

EFFECT OF GROWTH PARAMETERS ON SUBSTRUCTURE SPACING IN NaCl ICE CRYSTALS,
Cold Regions Research and Engineering Laboratory, Hanover, N.H.
G. Lofgren, and W. F. Weeks.
Journal of Glaciology, Vol 8, No 52, p 153-163, February 1969. 8 fig, 31 ref.

Descriptors: *Crystallography, *Ice, *Crystal growth, *Salinity, *Growth rates, Water chemistry, Cryology, Freezing, Crystallization, Mass transfer, Sea ice, Sea water, Salts.

Identifiers: *Ice structure.

The effect of growth velocity and solute concentration on the cellular substructure that develops in NaCl ice was studied in the range 0.003 to 0.00001 cm per sec and 1 to 100 parts per thousand, respectively. The substructure is the result of the formation of a constitutionally super-cooled zone in the liquid ahead of the advancing interface. Unidirectional freezing runs were made by placing a cold plate in contact with the 'top' of the solution and using cold-plate temperatures of -20 and -70 degrees C. The growth velocities were determined from a least-squares fit of the growth data to a power series. The average spacings between neighboring substructures were measured from photomicrographs of precisely located thin sections. Log-log plots of spacing against v show that the slope n gradually changes as a function of v. In the run where no convection occurred, n changed from 1/2 to 1 as v decreased. When convection occurs, n changes from 1/2 to approximately 0 as v decreases. This is caused by convection reducing the effective value at C at the growing interface. The variation of spacing with C is quite complex and shows a minimum in the composition range 9 to 25 parts per thousand NaCl. (Knapp-USGS) W72-02092

MODEL OF SPRING RUNOFF FORMATION AND ITS APPLICATION TO HYDROGRAPH FORECASTING (MODEL' FORMIROVANI VESENNEGO STOKA I VYE REALIZATSIIA DLYA PROGNOZA GIDROGRAFA),
Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr, Leningrad (USSR).

For primary bibliographic entry see Field 02E. W72-02096

WINTER COMMERCE ON THE BALTI: SOME IMPLICATIONS ON OPENING THE GREAT LAKES,
Michigan State Univ., East Lansing. Graduate School of Business.

For primary bibliographic entry see Field 06B. W72-02143

DETERMINATION OF THE THREE-DIMENSIONAL VELOCITY FIELD IN A GLACIER,
California Inst. of Tech., Pasadena. Div. of Geological Sciences.

C. F. Raymond.
Journal of Glaciology, Vol 10, No 58, p 39-53, 1971. 7 fig, 2 tab, 7 ref. NSF Grants GP-5447 and GU-2655.

Descriptors: *Glaciers, *Movement, *Flow, *Measurement, *Strain, Surveys, Borehole geophysics, Slopes, Rheology, Ice, Boreholes, Instrumentation.

Identifiers: Athabasca Glacier (Canada).

A method is given for the determination of the three-dimensional velocity field in a glacier. Measurements in three or more boreholes arranged in an appropriate array are needed for its application.

WATER CYCLE—Field 02

Evaporation and Transpiration—Group 2D

Surface motion, borehole profiles, and the geometry of the bed are all considered simultaneously in order to determine the velocity field. The basic assumption is that velocity between the boreholes can be represented by suitable interpolation based on the measurements in the holes. Ice displacement parallel to boreholes is calculated indirectly from incompressibility and the constraint that velocity normal to the bed be zero. As an example, the method is applied to an array of 9 boreholes in Athabasca Glacier. (Knapp-USGS) W72-02147

ANALYSIS OF SNOWMELT PHENOMENA IN 1963 AND 1964 IN CATCHMENT AREAS OF THREE MOUNTAIN STREAMS (IN POLISH), Wyzsza Szkoła Rolnicza, Krakow (Poland).

Zofia Kurek, and Stanislaw Kurek.
Roczn. Nauk Roln. Ser F Melioracji Uzutkow Zielonych. 77 (2): 283-295. Illus. 1969, (English summary).
Identifiers: Catchment, Cover, Mountain, Phenomena, Plant, Runoff, Snowmelt, Soil, Streams, Temperature.

Results of observations are presented on the snowmelt phenomena in the catchment areas of the Czarna Woda, Biala Woda and Skalski streams, and in the upper course of the Grajcarek, a tributary of the Dunajec river. With the observations, the 2-yr period, viz. 1962/63 and 1963/64 was covered. With the analysis of winters previous to snowmelts, the dynamics of the snow cover disappearance, the unit runoff rates and the course of air, snow and soil temperature, insolation, slope exposition and plant cover were determined. The forest contribution to check the snowmelt course and to its prolongation, diminishing at the same time the flood wave culmination was also observed. The air temperature course during insolation snowmelts was different than during advective ones; in the former there were wide amplitudes between day and night, while in the latter the differences were insignificant. (Popkin-Arizona) W72-01748

PROGRESS IN DEVELOPING FOREST MANAGEMENT GUIDELINES FOR INCREASING SNOWPACK WATER YIELDS, Arizona Univ., Tucson. Dept. of Watershed Management.

For primary bibliographic entry see Field 04A.

W72-02230

2D. Evaporation and Transpiration

ECOPHYSIOLOGICAL STUDIES ON PLANTS IN ARID AND SEMIARID REGIONS IN WESTERN AUSTRALIA. IV. COMPARISON OF THE FIELD PHYSIOLOGY OF THE HOST, ACACIA GRASBYI AND ITS HEMIPARASITE, AMYEMA NESTOR UNDER OPTIMAL AND STRESS CONDITIONS, Western Australia Univ., Nedlands. Dept. of Botany.

For primary bibliographic entry see Field 02I.
W72-01740

ENERGY BALANCE AND SPECTRAL PROPERTIES OF A REFLECTORIZED SOYBEAN CANOPY, Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry. For primary bibliographic entry see Field 03F. W72-01747

LYSIMETRIC AND ENERGY BALANCE DETERMINATION OF SLATFENCE AND TREE WINDBREAK EFFECTS ON WATER USE EFFICIENCY, Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry. D. R. Miller.

University of Nebraska, Agricultural Experiment Station, 280 p. July 1971. 103 fig, 20 tab, 6 app., 75 ref.

Descriptors: *Lysimeters, *Energy budget, *Windbreaks, *Irrigation efficiency, *Water conservation, Trees, Microclimatology, Water utilization, Evapotranspiration, Soybeans, Wind velocity, Air temperature, Carbon dioxide, Gradation, Dry farming, Irrigated land.
Identifiers: *Bowen Ratio.

Influence of slat-fence windbreak (50 percent density) and of permeable tree shelterbelt on microclimate and water-use efficiency was studied in 2 experiments involving measurements of microclimate and lysimetric evapotranspiration by irrigated soybeans. Slat-fence reduced wind speed by 40 percent at 4H (H equals height of shelterbelt), increased shear, and neutralized atmospheric stability. Shelterbelt was most effective in reducing wind speed when winds were light and the incidence angle was slightly oblique. Bowen-Ratio-Energy-Balance-determined exchange coefficients agreed with lysimetric observations. Air temperature and carbon dioxide gradients are discussed. Slat fence reduced evapotranspiration of soybeans significantly. Wind shelter increased water-use efficiency of irrigated soybeans. Tree shelterbelts will also increase water-use efficiency in dryland situations. Numerous figures and tables quantify relationships. (Popkin-Arizona) W72-01748

WATER TRANSPORT IN RELATION TO EXPANSION AND CONTRACTION OF LEAVES AND FRUITS OF 'CALAMONDIN' ORANGE, Wisconsin Univ., Madison. Dept. of Forestry.

W. R. Chaney, and T. T. Kozlowski.
J. Hort. Sci. 46 (1): 71-81. Illus. 1971.
Identifiers: Calamondin, Contraction, Drought, Expansion, Fruits, Irrigation, Leaves, Orange-D, Relation, Transpiration, Transport.

Diurnal fluctuations in fruit diameter and leaf thickness of 'Calamondin' orange trees were measured and related to transpiration from leaves and to internal redistribution of water from fruits to leaves. While trees were well irrigated, leaf thickness began to decline daily around sunrise and to increase in mid-afternoon. Daily shrinkage and expansion of fruits began later than in leaves. The lag in response of leaf thickness changes to changes in vapor pressure deficit of the air was 1 or 2 hr, whereas the lag in response of fruit diameter was 3 or 4 hr. During imposed droughts, daily shrinkage of fruit and leaves continued until later in the day when the trees were well irrigated. Moreover, during a drought, expansion of the tissues at night occurred at a much slower rate than during periods of daily irrigation, or expansion did not occur at all. Movement of water from fruits to leaves on excised branches was indicated by the higher percentage moisture content of leaves on branches bearing fruits than of leaves on branches without fruits. (Popkin-Arizona) W72-01892

WATER LOSS IN FOREST TREE SEEDLINGS AND THEIR WATERHOLDING CAPACITY (IN CZECH),

Vysoka Skola Zemedelska, Brno (Czechoslovakia). Fakulta Lesnicka.
P. Penka.

Ved Cas Ustav Vedeckotech Inform Les. 16 (3): 281-295. Illus. 1970. English summary.

Identifiers: Alnus-Glutinosa-D, Drought, Forest, Irrigation, Larix-Decidua-G, Loss, Picea-Excelsa-G, Pinus-Sylvestris-G, Resistance, Seedlings, Tilia-Cordata-D, Tree, Waterholding.

With Pinus sylvestris, Picea excelsa, Larix decidua, Tilia cordata and Alnus glutinosa, there are 2 types of daily transpiration: midday maximum and midday depression. The levels of transpiration in experimental seedlings are very high at night. After midnight the 9th, 12th, 14th and 17th hours are

most convenient for establishing changes in transpiration in woody and herbaceous plants. Irrigation should be applied either at 6-8 a.m. or 6-8 p.m. After abscission of a woody species seedling, water loss should be determined after 0, 60, 120, and 240 min. The resultant water loss from 60 to 120 min is criterion of resistance to drought. (Popkin-Arizona) W72-01905

POTENTIAL EVAPORTION, (IN DUTCH), G. F. Makink, and H. D. J. Van Heemst.
Inst Biol Scheik Onderz Landbouwgewassen Wageningen Meded. 417. 1-10. Illus. 1970. English summary.

Identifiers: Crop, Evaporation, Formula, Green, Penman, Potential.

The Penman formula is applied with the aerodynamical wind function, for a free water surface and for a green crop, covering the field completely and optimally provided with water. (Popkin-Arizona) W72-01946

INFLUENCES OF EXPOSURE ON PAN EVAPORATION IN A MOUNTAINOUS AREA, Utah Water Research Lab., Logan; and Environmental Science Services Administration, Rockville, Md.

Eugene L. Peck.
PhD thesis, June 1967, 132 p, 45 fig, 8 tab, 54 ref.

Descriptors: *Evaporation, *Mass transfer, Air masses, Air temperature, Atmospheric pressure, Dewpoint, Elevation, Evaporation pans, Instrumentation, Meteorology, Networks, Radiation, Topography, Vapor pressure, Water temperature, Wind velocity.

Identifiers: *Station exposure, Aerodynamic equation, Christiansen method, Drainage winds, Heat flux, Land slope, Lake Hefner, Lake Mead, Pan wind movement, Richardson number, Stability index, Upper air flow.

A network of 12 Class A evaporation stations were operated during the summer months of the years 1962-66. Twenty different sites with widely varying exposures were used. Elevations ranged from 4,205 ft. to 8,960 ft. Deviations from mean relations with elevation of monthly values of observed meteorological factors were found to be related to the type of exposure. Dewpoint observations on different slopes were found to be related to station exposures, stability of air mass, and direction of upper air flow. Two commonly used methods for estimating monthly pan evaporation were found to be within 3 and 6 percent of observed values. The reliability of the revised mass transfer equations and the effect of elevation (atmospheric pressure) on evaporation rates were investigated. (NOAA abstract) W72-02119

CHANGES IN THE RATIO BETWEEN SUGAR BEET EVAPOTRANSPIRATION AND PAN EVAPORATION DURING THE GROWING SEASON,

Hebrew Univ., Rehovot (Israel). Faculty of Agriculture.

For primary bibliographic entry see Field 03F.
W72-02179

A HYDROSTATIC LYSIMETER TO MEASURE EVAPOTRANSPIRATION UNDER REMOTE FIELD CONDITIONS,

Laurentian Univ., Sudbury (Ontario). Dept. of Biology.

G. M. Courtin, and L. C. Bliss.

Arctic Alp Res. 3 (1): 81-89. Illus. 1971.

Identifiers: Carex-Bigelowii-M, Diapensia-Lapponica-D, Evapo, Field, Hydrostatic, Lysimeter, Measure, Remote, Transpiration.

Field 02—WATER CYCLE

Group 2D—Evaporation and Transpiration

A small hydrostatic lysimeter for use in shallow tundra soils was constructed based on the design of Hanks and Shawcroft (1965). A percolation vessel situated below the lysimeter drained the lysimeter of excess water induced by heavy rainfall and gave a measure of the amount retained by the soil and that lost from the soil. Soil temperature and moisture measured within the lysimeter and in the adjacent soil indicate that natural conditions were closely duplicated in the lysimeter in spite of its small size. Measurement of wind velocity in the vicinity of the lysimeter indicated that the unvegetated boundary at the edge of the lysimeter has more effect in a sedge community of *Carex bigelowii* than in a cushion plant community of *Diapensia lapponica*. The use of a sealed 'dummy' lysimeter in conjunction with lysimeters containing live plant systems permitted correction of all environmental variables, the major one being temperature. A suggestion was made for the way in which the transpiration data might be analyzed, and expressed on a gram per square decimeter of leaf area per hour basis. The lysimeter was constructed from inexpensive and easily obtainable materials. It had an accuracy equal to 0.25 mm of water and was found to be a simple and accurate way of measuring evapotranspiration in an alpine tundra environment.—Copyright 1971, Biological Abstracts, Inc.
W72-02187

SEASONAL EFFECTS ON SOIL DRYING AFTER IRRIGATION,

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

B. A. Kimball, and R. D. Jackson.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 85-98, 1971. 1 fig, 2 tab, 4 ref.

Descriptors: *Evaporation, *Arid lands, *Lysimeter, *Soil water movement, Soil moisture, Arizona, Temperature, Drying, On-site data collections, Diurnal, Seasonal, Irrigation, Loam.

Identifiers: *Soil drying, *Potential evaporation, *Bare soils.

A study was made to determine how the evaporation rate from a bare Adelanto loam soil in Phoenix changes with season and with time since the last irrigation. The evaporation rates were determined by precision lysimeters in a bare field, with measurements being taken in every month of the year for at least a week after irrigation. The data exhibited a cosine-shaped curve, with a maximum evaporation rate of about 5 mm/day in summer and a minimum rate of about 2 mm/day in winter. By the seventh day, seasonal effects virtually disappear, and the evaporation rate is the same in both summer and winter, being about 2 mm/day after the 7th day and about 0.75 mm/day after the 21st day. It is generally accepted that soil dries in 3 stages, and the transition between the 1st and 2nd stages occurs when atmospheric conditions are no longer critical. In previous laboratory studies of soil drying, with constant atmospheric conditions, stage I was easily distinguished from stage II, and these results correlated closely with the equations of Gardner and Hillel. The individual drying curves of this field study were qualitatively different from the laboratory studies and did not confirm the predictions of the equations, suggesting that diurnal variations in temperature and other meteorological parameters have caused the difference. (See also W72-02212) (Casey-Arizona)
W72-02217

EVAPORATIVE COOLING TECHNIQUES FOR REGULATING PLANT WATER STRESS,

R. L. Carolus.

Hortscience, 6 (1 Sec 1): 1971. 23-25.

Identifiers: Blossom, Blotchy, Climate, Cooling, End, Evaporative, Germination, Growth, Harvesting, Mechanical, Onion-M, Plant, Potato-D, Regu-

lating, Ripening, Rot, Stress, Techniques, Temperature, Tomato-D.
W72-02242

2E. Streamflow and Runoff

STATISTICAL INFERENCE ON STREAMFLOW PROCESSES WITH MARKOVIAN CHARACTERISTICS,

Arizona Univ., Tucson, Dept. of Mathematics. J. L. Denny, C. C. Kisel, and S. J. Yakowitz. (1971), 31 p, 28 ref. OWRR-A-023-ARIZ (2).

Descriptors: *Streamflow, *Semiarid climates, *Model studies, *Arizona, Runoff, Statistical methods, Mathematical studies, Markov processes, Stochastic processes, Ephemeral streams.

A model of Southern Arizona streamflows in terms of a random process is formulated as a function of a Markov process with stationary transition probabilities. The process is approximated by a higher order Markov process with stationary transition probabilities. Streamflow data from measuring stations in Arizona are applied to study questions about changes in the frequency of moderately long wet and dry periods, prediction of streamflow behavior using only past streamflow records, long range trends of streamflow, and other problems. The results of the analysis of Sabino Creek data in terms of its wet-dry properties include: (1) Statistical evidence that the wet-dry sequence in the January-February period may be described as a Markov chain of order 5 (days) and with stationary transition probabilities, (2) statistical evidence that a Markov chain of order 4 with stationary transitions adequately describes the summer period, and (3) comparison of distribution functions for actual and simulated dry runs and wet runs for the Sabino summer flows gives strong evidence that the actual data is a chain of order 5. The greatest discrepancy occurs at the 100 percentile for the wet runs; this indicates some problem with extremes. (Woodard-USGS).
W72-01704

DISCONTINUITIES IN STRATIFIED FLOWS,

Waterloopkundig Laboratorium, Delft (Netherlands).

G. Abraham, and C. B. Vreugdenhil.

Journal of Hydraulic Research, Vol 9, No 3, p 293-308, 1971. 4 fig, 1 tab, 9 ref.

Descriptors: *Stratified flow, *Mixing, *Saline water-freshwater interfaces, *Density currents, Hydraulics, Density stratification, Turbulent flow, Turbulence, Saline water intrusion, Interfaces.

Exchange flows provide an example of stratified flow in which discontinuities occur. The salt water front penetrates into fresh water, which is lifted upwards. Hence, vertical velocity components occur at the discontinuity. The horizontal velocity component is not distributed homogeneously over the heights of the upper layer at the discontinuity. The velocity of propagation of a salt water front is given by an equation which contains numerical coefficients to express the effects on non-homogeneous velocity-distributions, energy losses at the discontinuity, and bottom shear. (Knapp-USGS)
W72-01723

DETERMINATION OF THE LOOP DISCHARGE RATING CURVE FOR FLOOD WAVE PROPAGATION,

Bulgarian Academy of Sciences, Sofia. Inst. for

Hydrology and Meteorology.

G. Gergov.

Journal of Hydraulic Research, Vol 9, No 3, p 309-319, 1971. 5 fig, 7 ref.

Descriptors: *Stage-discharge relations, *Unsteady flow, *Floods, *Hydrograph analysis, Hydrographs, Numerical analysis, Hydrophase diagrams, Discharge (Water), Flood forecasting.

Identifiers: St.-Venant equations, Flood waves.

The form of the discharge rating curve, and especially its upper part, must be known to forecast flood wave propagation. Flood waves are examples of unsteady flow, and their discharge-rating curves are loops. The loop discharge-rating curve may be determined by direct computation, calculating changes of the hydraulic characteristics of the unsteady flow at a given point. De Saint-Venant's differential system for an unsteady flow is used, assuming that: The water movement is two dimensional; the hydraulic characteristics are gradually variable with continuous derivatives along the river's reach; the resistance forces are similar to those in a steady flow; and the morphometrical characteristics of the river reach are nearly constant in time. (Knapp-USGS)
W72-01724

TRANSIENT MOTIONS INDUCED BY LOCAL DISTURBANCES IN A LINEARLY DENSITY-STRATIFIED FLUID,

Tetra Tech, Inc., Pasadena, Calif.

R. C. Y. Koh.

Journal of Hydraulic Research, Vol 9, No 3, p 335-353, 1971. 6 fig, 6 ref. USN Contract N00014-67-C-0270.

Descriptors: *Stratified flow, *Waves (Water), *Density stratification, Numerical analysis, Mathematical studies, Flow, Hydrodynamics, Fluid mechanics.

The internal hydrodynamic motions induced in a linearly stratified fluid by an arbitrary two dimensional disturbance were determined. Closed-form integral expressions for the solutions are presented; two fundamental solutions for the motion subsequent to an initial disturbance correspond to the hydrodynamic motions resulting from an initial displacement of the water mass from the position of static equilibrium (distortion of isopycnal lines) or an initial velocity distribution throughout the water mass. The complete solution resulting from an arbitrary disturbance is a superposition of the two basic solutions with appropriate forcing functions. (Knapp-USGS)
W72-01726

LINEAR PROPORTIONAL WEIRS WITH TRAPEZIODAL BOTTOMS,

Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.

For primary bibliographic entry see Field 08B.

W72-01728

MULTI-SITE STREAMFLOW SIMULATION OF TRUCKEE RIVER, NEVADA,

Nevada Univ., Reno. Center for Water Resources Research.

V. L. Gupta, and J. W. Fordham.

Available from the National Technical Information Service as PB-204 705, \$3.00 in paper copy, \$0.95 in microfiche. Paper presented at the IASPS Symposium on 'Statistical Hydrology' Tucson, Arizona, August 31-September 2, 1971, (1971). 45 p, 15 fig, 4 tab, 12 ref, Append. OWRR C-2153 (No 3372) (1); C-1105 (No 1582) (2).

Descriptors: *Streamflow, *Simulation analysis, Monthly, Sequence, Flow, Model studies, Hydrologic budget, Water demand, Nevada, California, Stochastic processes, Markov processes, Statistical models.

Identifiers: Truckee River, Donner, Prosser, Boca, Farad.

Simulated monthly streamflow sequences in a six-satellite-station configuration within Tahoe-Truckee river system in California-Nevada, were examined in terms of (1) salient features of methodology, and (2) water budget. Problems encountered include imbalance of water budget, and issues associated with handling non-current historic flow sequences. Study has revealed critical needs for further research in the premise of streamflow synthesis as related to a multi-site situation. These include (1) incorporation of hydrologic water-

WATER CYCLE—Field 02

Streamflow and Runoff—Group 2E

budget in the rationale for simulation, (2) more robust statistical techniques for testing adequacy and reliability of simulated sequences, (3) experimentation with non-Markovian generating schemes, (4) sample length requirements in relation to the bounds of simulated sequences, and (5) influence of smoothing the parameter estimates. W72-01778

A CRITICAL REVIEW OF CURRENTLY AVAILABLE HYDROLOGIC MODELS FOR ANALYSIS OF URBAN STORMWATER RUNOFF.
Hydrocomp International Inc., Palo Alto, Calif.
For primary bibliographic entry see Field 02A.
W72-01978

SPECTRAL DENSITY OF A RIVER FLOW TIME SERIES,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
K. Adamowski.
Journal of Hydrology, Vol 14, No 1, p 43-52, October 1971. 2 fig, 2 tab, 6 ref.

Descriptors: *Time series analysis, *Stochastic processes, *Streamflow, Fourier analysis, Probability, Statistical methods, Statistics, Regression analysis, Streamflow forecasting, Data processing.

A periodogram approach was used to estimate the spectral density of a stochastic component of a daily river flow time series. A goodness-of-fit test allows comparisons of spectra, and suggests criteria for the length of records for spectral analysis. A daily river discharge time series for the Thames River, Ontario, was selected for the analysis. The series consisted of 45 years of data (1920-1966) with the arithmetic mean equal to 475 CFS, and the standard deviation equal to 813 CFS. Fifteen years of data gives an estimation of spectral density which does not differ significantly from the spectral density estimated from forty-five years of data at 95% confidence limit. Shorter samples of five or ten years in length, give estimations of spectral density which differ significantly from that computed from forty-five or fifteen years of data. For practical purposes, about fifteen years of daily records should be used to obtain an estimation of the spectral density. A shorter sample is inadequate and a longer sample, up to forty-five years in length, yields no better estimate. (Knapp-USGS)
W72-02010

ANALYSIS OF PERIODICITY IN HYDROLOGICAL SEQUENCES,
Karlova Universita, Prague (Czechoslovakia).
Dept. of Mathematics and Statistics.
For primary bibliographic entry see Field 02A.
W72-02012

OCEAN SPECTRA FOR THE HIGH-FREQUENCY WAVES AS DETERMINED FROM AIRBORNE RADAR MEASUREMENTS,
Naval Research Lab., Washington, D. C.
For primary bibliographic entry see Field 07B.
W72-02014

DRAG FORCES ON BAFFLE BLOCKS IN HYDRAULIC JUMPS,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 08B.
W72-02019

HYDRAULIC JUMP ASSISTED BY CROSS-JET,
Kentucky Univ., Lexington, Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W72-02020

SEICHE MOTIONS FOR A BASIN OF RECTANGULAR PLAN AND OF NONUNIFORM DEPTH,
Wollongong Univ. Coll. (Australia). Dept. of Mathematics.
D. J. Clark.

Journal of Marine Research, Vol 29, No 2, p 47-59, May 15, 1971. 1 fig, 9 tab, 5 ref.

Descriptors: *Seiches, *Waves (Water), Surges, Numerical analysis, Equations, Tides, Ocean waves, Lakes, Mathematical models.

The two-dimensional modes of oscillation of a fluid in a rectangular basin were found from the linearized equations of motion in terms of transport variables by employing an extension of Galerkin's method. The depth function is arbitrary in so far as the vertical accelerations remain negligible, and is chosen as a first-degree function of the space variables to illustrate the technique. An alternative approach, using wave height as the dependent variable, is also given. Comparison with one-dimensional-flow theory shows errors in that theory of up to 17% or more when the depth varies within the region. (Knapp-USGS)
W72-02031

SPATIAL STRUCTURE OF INERTIAL-PERIOD MOTIONS IN A TWO-LAYERED SEA, BASED ON OBSERVATIONS,
Kiel Univ. (West Germany). Institut fuer Meereskunde.

F. Schott.
Journal of Marine Research, Vol 29, No 2, p 85-102, May 5, 1971. 8 fig, 5 tab, 14 ref.

Descriptors: Seiches, *Ocean waves, Winds, Waters (Water), Instrumentation, *Hydrodynamics, Currents (Water), Ocean currents, Thermocline, Thermal stratification.
Identifiers: Inertial oscillations (Oceans).

Spatial coherence and phase relationships of inertial-period motions were measured using 4 current meters in the northern North Sea where the density profile was almost two-layered. The inertial-period currents showed antiphase between the upper and lower layers; the coherence between both layers was high. The inertial-period temperature fluctuations were in phase throughout the thermocline. Internal waves are generated by wind and have frequencies that are higher than the inertial frequency, and in the course of time these frequencies decay to the inertial frequency. During this frequency variation, the vertical components of the internal waves decline more quickly than do the horizontal currents. Therefore, the current oscillations contain more energy at the very small wave-numbers than do the temperature fluctuations. This is demonstrated by the horizontal phase differences of currents and temperature fluctuations. For one sudden wind-stress change, high forced oscillations were apparent in these time series, but after only a few cycles the energy of the forced oscillations had shifted toward the zero wave-numbers. (Knapp-USGS)
W72-02033

NEW EVIDENCE OF THE EQUATORIAL UNDERCURRENT EAST OF THE GALAPAGOS ISLANDS,
Scripps Institution of Oceanography, LaJolla, Calif. Inter-American Tropical Tuna Commission.

M. R. Stevenson, and B. A. Taft.
Journal of Marine Research, Vol 29, No 2, p 103-115, May 15, 1971. 4 fig, 2 tab, 15 ref.

Descriptors: *Ocean currents, *Pacific Ocean, *Density currents, Salinity, Ocean circulation, Currents (Water), Oceanography.
Identifiers: Equatorial undercurrent.

The subsurface current beneath the Equatorial Front between the Galapagos Islands and Ecuador is the eastward extension of the Equatorial Undercurrent. The Undercurrent extends eastward of the Galapagos and may be found within 110 km of

the coast of Ecuador and northern Peru. It is possible that all of the Undercurrent water is not found underneath the Front. Some portion of the Undercurrent water may be found farther south of the equator. The high-salinity core of the Undercurrent is characterized by a salinity maximum of 35.13-36.17 parts per thousand, a temperature of 17.2 deg C, and a thermocline anomaly of 239 cft/ton; it is most frequently found at a depth of 68 m. The Undercurrent may retain eastward velocities of up to 37 cm sec. (Knapp-USGS)
W72-02034

OBSERVATIONS ON SHORT-PERIOD INTERNAL WAVES IN MASSACHUSETTS BAY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
For primary bibliographic entry see Field 02L.
W72-02035

ON POTENTIAL DENSITY IN THE DEEP SOUTH ATLANTIC OCEAN,
National Marine Fisheries Service, La Jolla, Calif. Fishery-Oceanography Center.
R. J. Lynn.

Journal of Marine Research, Vol 29, No 2, p 171-177, May 15, 1971. 5 fig, 10 ref.

Descriptors: *Density, *Sea water, *Atlantic Ocean, *Density stratification, Ocean currents, Ocean circulation, Salinity, Water temperature, Thermal stratification.
Identifiers: Potential density (Sea water).

There is a great contrast between the relative distributions of potential density referred to 0 decibars and of potential density referred to 4000 decibars in the deep water of the South Atlantic Ocean. Both parameters are useful in a descriptive analysis of deep water; the former is an identifier of water origin, the latter graphically displays stability in the deep ocean and can be used to infer deep-ocean geostrophic flow. (Knapp-USGS)
W72-02037

A STABLE SPAR-BUOY PLATFORM FOR MOUNTING INSTRUMENTATION,
Naval Underwater Systems Center, Newport, R. I.
For primary bibliographic entry see Field 07B.
W72-02039

PACIFIC BOTTOM WATER: PENETRATION EAST AROUND HAWAII,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.

J. M. Edmond, Y. Chung, and J. G. Slater.
Journal of Geophysical Research, Vol 76, No 33, p 8089-8097, November 20, 1971. 9 fig, 16 ref. ONR Contract N0014-67-A-0204-0048.

Descriptors: *Ocean currents, *Ocean circulation, *Pacific Ocean, Hawaii, Oceanography, Currents (Water), Water temperature, Bathymetry, Topography, Mixing.
Identifiers: Pacific bottom water.

A narrow eastward bottom current flows along the southern flanks of the mid-Pacific mountains, through a deep passage 10 km wide south of Horizons guyot and on around the southeastern end of the Hawaiian chain. Deviations of the abyssal water temperature profiles from normal adiabatic type to highly subadiabatic are evidence of continuous input of a cold bottom water layer. Abrupt changes in the vertical gradients of temperature and dissolved constituents mark the boundary between the Bottom Water and the Deep Water. (Knapp-USGS)
W72-02040

WATER EXCHANGE AT THE MOUTH OF THE GULF OF CALIFORNIA,
Florida State Univ., Tallahassee. Dept. of Oceanography.
C. E. Marsh, and K. L. Marsh.

Field 02—WATER CYCLE

Group 2E—Streamflow and Runoff

Journal of Geophysical Research, Vol 76, No 33, p 8098-8106, November 20, 1971. 7 fig, 1 tab, 14 ref.

Descriptors: *Water balance, *Currents (Water), *Ocean currents, *Ocean circulation, Density currents, Stratification, Salinity, Hydrologic budget, Water temperature, Evaporation, Rainfall.

Identifiers: *Gulf of California, *Geostrophic flows.

Computations for water mass exchange at the mouth of the Gulf of California were based on a model that considers only geostrophic flow with a reference level adjusted to obtain agreement between inflow and outflow. The minimum transports are 2.57 to 3.65 Sv. The difference between the average salinity of the outflow and the inflow is zero for May 1959, negative for July 1967, and positive for February 1957. The average of the three values is negative, which would indicate that precipitation and runoff exceeds evaporation. (Knappe-USGS)
W72-02041

SURFACE-WATER RESOURCES OF THE OB RIVER AND OB-IRTYSH INTERFLUVE (RESURSY POVERKHONSTYNYKH VOD R. OBI I OB-IRTYSHSKOGO MEZHDURECH'YA),
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).

For primary bibliographic entry see Field 04A.

W72-02065

FORMATION OF SPRING RUNOFF IN THE VASYUGAN'YE (O FORMIROVANII VESENNEGO STOKA V USLOVIYAKH VASYUGAN'YA),

Tomsk State Univ. (USSR).

For primary bibliographic entry see Field 04A.

W72-02068

SALINITY OF SURFACE WATER IN THE LOWER COLORADO RIVER - SALTON SEA AREA,

Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02K.

W72-02074

FLOODS IN HARVARD SOUTHWEST QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Oak Park, Ill.

R. T. Mycyk, and R. S. Grant.

Geological survey Open-file report, August 1971. 10 fig, 1 plate, 3 tab, 1 ref.

Descriptors: *Floods, *Flood damage, *Flood plains, *Illinois, Regional flood, Flood forecasting, Flood control, Historic flood, Peak discharge, Stream gages, Flow measurement.

Identifiers: Flood recurrence intervals, Flood profiles.

Floods in Harvard Southwest quadrangle, northeastern Illinois are described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections and other material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. The total program includes part of Cook County, nearly all of Kane and Will Counties, and all of Du Page, Lake and McHenry Counties. There are several depressions and lowland areas in the quadrangle where surface water accumulates because of inadequate drainage into the streams. Frequency and depth of flooding in these areas are unrelated to the water-surface elevation along the streams. Some areas are flooded only briefly after periods of heavy rainfall or snowmelt, whereas others remain inundated continuously, depending largely upon the rate of evaporation and seepage into the ground. (Woodard-USGS)
W72-02085

MODEL OF SPRING RUNOFF FORMATION AND ITS APPLICATION TO HYDROGRAPH FORECASTING (MODEL' FORMIROVANIYA VESENNEGO STOKA I YEYE REALIZATSIIA DLYA PROGNOZA GIDROGRAFA),
Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr, Leningrad (USSR).
Ye. G. Popov, A. P. Zhidikov, A. G. Levin, and N. S. Nechayeva.
Meteorologiya i Gidrologiya, No 6, p 92-101, June 1971. 3 fig, 1 tab, 4 ref.

Descriptors: *Runoff, *Runoff forecasting, *Hydrographs, *Model studies, Water storage, Discharge (Water), Melt water, Snowmelt, Snow, River basins.

Identifiers: *USSR.

Spring-runoff hydrographs for an open basin (the Oka River up to Ore) and for a forested basin (the Neya River up to Buslayevo) were defined in a model on the basis of statistical descriptions of the distribution of water storage in snow for the periods 1949-65 and 1936-65, respectively. Four assumptions were included in the model: (1) the maximum amount of water temporarily stored under snow results in a maximum increase in runoff during the period of high water; (2) the temporary storage of water under snow ceases when the extent of the basin area covered by snow is 85-90%; (3) the discharge of temporarily stored water begins when the index of basin area coverage by snow is 85-90% and ceases when the index is 15-20%; and (4) the rate of decline in water storage is approximated by a function of a hyperbolic cosine. The forecast reliability of the model was evaluated on the basis of the integral of the squares of the difference between computed and actual water discharges and was considered optimal when the integral was minimal. (Josefson-USGS)
W72-02096

HYDROLOGY AND WATER RESOURCES IN ARIZONA AND THE SOUTHWEST, VOLUME I
American Water Resources Association.

For primary bibliographic entry see Field 04A.

W72-02212

AUGMENTING ANNUAL RUNOFF RECORDS USING TREE-RING DATA,

Arizona Univ., Tucson, Lab. of Tree-Ring Research.

C. W. Stockton, and H. C. Fritts.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section - American Water Resources Association, and the Hydrology Section - Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 1-12, 1971. 4 fig, 7 tab, 5 ref. OWRR B-007-ARIZ (20).

Descriptors: *Runoff, Climatic data, *Statistical models, *Mathematical studies, Watersheds (Basins), Arizona, New Mexico, Precipitation (Atmospheric), Temperature, Evapotranspiration, Seasonal, Spatial distribution, Time series analysis, Sampling, Correlation analysis, Regression analysis, Variability, Arid lands, Hydrologic data.

Identifiers: *Analysis of covariance, *Principal components analysis.

Statistical analyses of existing hydrologic records suffer from the problem that such records are of relatively short duration, and therefore may not necessarily be random samples of the infinite population of events. On the hypothesis that tree-ring series and runoff series respond to a common climatic signal or signals that permit prediction of annual runoff from annual ring-width index, tree-ring data are used to extend available runoff records backwards in time to permit more accurate estimates of the 3 most common statistics used in hydrology: the mean, the variance and the 1st order correlation. It is assumed that both series are generated by the climatic parameters of precipitation, temperature, evapotranspiration, seasonal regime and spatial distribution. Of major concern in the reconstruction of annual runoff series from tree-ring records was the difference in persistence

within each of the 2 series. A matrix of the tree-ring data was constructed, lagged up to 3 times and principal components were extracted. The covariance in this matrix was then decomposed by extracting the eigen-vectors, and multiple regression was then used to weight the respective series and the differences in persistence were determined. This method was applied to watersheds of diverse characteristics and improved estimates of the mean and variance were obtained. (See also W72-02212) (Casey-Arizona)
W72-02213

CONDITIONAL STREAMFLOW PROBABILITY DISTRIBUTIONS,

Arizona Univ., Tucson, Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 06A.

W72-02223

A STOCHASTIC ANALYSIS OF FLOWS ON RILLITO CREEK,

Arizona Univ., Tucson, Dept. of Hydrology and Water Resources.

N. E. Baran, D. C. Kisiel, and L. Duckstein.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section - American Water Resources Association and the Hydrology Section - Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 171-210, 1971. 3 fig, 7 tab, 5 ref. OWRR B-007-ARIZ (20).

Descriptors: *Stochastic processes, *Model studies, *Statistical models, *Ephemeral streams, *Streamflow, Arid lands, Arizona, Regression analyses, Correlation analyses, Intermittent streams, Probability, Hydrographs, Flow characteristics, Time series, Analysis, Runoff forecasting, Simulation analysis.

Identifiers: *Analysis of variance, *Antecedent dry periods.

In order to construct a simulation model for ephemeral streamflow and to examine in depth the problem of the worth of data for that model, measurements of the ephemeral streamflow of Rillito Creek, Tucson, were analyzed for the period 1933-1965. The simulation model was based on several hypotheses: (1) flow durations and their succeeding dry periods (time when no flow is present) are independent; (2) the distribution of the lengths of the dry periods and flows is stationary over a certain period of the year (summer); (3) stationary probability distributions for flow durations and for dry period lengths can be derived. A related problem was how to derive a simulation model for the total amount of flow (in acre-ft) within 1 flow period. Three variables were considered: flow duration (minutes), peak intensity of flow (cu ft/sec) and antecedent dry period-minutes (ADP). Because the assumption of variance constancy does not hold, a multiplicative regression model was used. Using an analysis of variance, which is described in detail, the worth of the 3 kinds of data were examined in relation to total flow. It was concluded that there are at least 5 times during the year when the flow intervals differ significantly, and the ADP is not important in determining flow volume because of the Poisson flow arrival rate in summer. Events occur at random and are not clustered as in summer, indicating that channel moisture does not differ much between flow events. (See also W72-02212) (Casey-Arizona)
W72-02224

2F. Groundwater

URANIUM AND TRITIUM AS NATURAL TRACERS IN THE FLORIDAN AQUIFER,
Florida State Univ., Tallahassee, Dept. of Geology.
For primary bibliographic entry see Field 04B.
W72-01696

WATER CYCLE—Field 02
Groundwater—Group 2F

REDISTRIBUTION OF GEOTHERMAL HEAT BY A SHALLOW AQUIFER,
Illinois Geological Survey, Urbana.

K. Cartwright.

Geological Society of American Bulletin, Vol 82, No 11, p 3197-3200, November 1971. 2 fig, 1 tab, 8 ref.

Descriptors: *Heat transfer, *Groundwater movement, *Illinois, Glacial drift, Aquifers, Heat flow, Advection, Mass transfer, Geothermal studies, Mathematical models, Water temperature, Temperature.

The distribution of temperature within the lithosphere can be significantly affected by the movement of water. A mathematical model for the effect of a shallow confined aquifer in Illinois on the soil temperature compared with field data suggests that about 10 percent of the geothermal heat was being redistributed. The quantity of geothermal heat redistributed by moving water in a shallow aquifer depends on the velocity of fluid movement and the thermal properties of the rock/fluid complex. (Knapp-USGS)
W72-01720

TRANSMISSIVITY TRACTS IN THE COASTAL PLAIN AQUIFERS OF MARYLAND,
Maryland Geological Survey, Baltimore.

H. J. Hansen.

Southeastern Geology, Vol 13, No 3, p 127-149, October 1971. 11 fig, 58 ref.

Descriptors: *Hydrogeology, *Aquifer characteristics, *Transmissivity, *Maryland, *Coastal plains, Aquifers, Alluvium, Groundwater movement, Water yield, Stratigraphy, Sedimentation, Atlantic coastal plain.

Identifiers: Coastal plain aquifers.

The Coastal Plain sediments of Maryland exhibit three major transgressive-regressive sedimentary cycles. In these cycles three major lithotypes are repeated. Regional transmissivity tracts (areas of high transmissivity) characteristic of the non-marine lithotype are generally subparallel to the regional dip. Formations of the marine lithotype exhibit tracts subparallel to the regional strike. The dip orientation suggests a predominance of fluvial input during deposition; the strike orientation suggests marine redistribution. Some transmissivity tracts occupy axial portions of a major landward extension of the Baltimore Canyon Trough, suggesting coarse detrital input from a long existing proto-Susquehanna drainage system. (Knapp-USGS)
W72-01730

CHEMICAL WEATHERING OF THE BISCAYNE AQUIFER, DADE COUNTY, FLORIDA,
Colorado Univ., Boulder. Dept. of Geological Sciences.

D. D. Runnells.

Southeastern Geology, Vol 13, No 3, p 167-174, October 1971. 3 fig, 10 ref.

Descriptors: *Weathering, *Limestones, *Aquifers, *Florida, Water chemistry, Leaching, Porosity, Groundwater movement, Aquifer characteristics, Water table, Karst, Hydrogeology, Permeability.

Identifiers: Biscayne aquifer (Fla.).

The content of calcium dissolved in rainwater in Dade County, Florida, is about 0.6 ppm, whereas the shallow groundwater contains an average of 77.2 ppm dissolved calcium. This difference in dissolved calcium is the result of the chemical weathering within the Biscayne aquifer. A theoretical total thickness of 24 feet of limestone could have been removed by chemical weathering since deposition and sub-aerial exposure of the Miami oolite about 130,000 years ago. The general lack of a karst topography in this area suggests that the actual lowering of the surface has probably been sub-

ordinate to the development of secondary porosity in the aquifer. Such porosity is well displayed immediately below the water table in the Miami oolite. Nearly three feet of residual quartz sand could theoretically have been produced by the weathering and lowering of the surface of the Miami oolite. (Knapp-USGS).
W72-01731

TIME IN TRANSIT OF WATER MOVING VERTICALLY FOR GROUND WATER RECHARGE,
Arizona Univ., Tucson. Dept. of Agricultural Chemistry and Soils.

For primary bibliographic entry see Field 02G.
W72-01750

CHANGE OF CHLORIDE CONTENT OF WATER IN RESPONSE TO PUMPING IN THE ARTESIAN AQUIFER IN THE ROSWELL-EAST GRANT PLAINS AREA, CHAVES COUNTY, NEW MEXICO,

New Mexico State Engineer Office, Albuquerque. For primary bibliographic entry see Field 04B.
W72-01751

SALINE LAKE BASINS OF THE SOUTHERN HIGH PLAINS,

Texas Tech Univ., Lubbock. Dept. of Geosciences. C. C. Reeves.

In: Saline Water, Mattox, R. B. (ed.), AAAS, Committee on Desert and Arid Zones Research, Contribution No 13, p 64-70, 1970. 2 fig, 1 tab, 7 ref.

Descriptors: *Lake basins, *Saline lakes, *Sodium sulfate, *Great Plains, *Saline water systems, Texas, Salts, Gypsum, Geologic formations, Geologic time.

Identifiers: *Lacustrine fills.

About 30 large lake basins of Pleistocene origin are found in the southern High Plains. These large pluvial basins contain thick lacustrine fills with bedded salts and large quantities of saline water. Composition of these salts is mainly restricted to gypsum or sodium sulfate. The sodium sulfate beds are restricted to the uppermost parts of the lacustrine section while the bedded gypsum occurs at various levels. The widespread distribution of gypsum in all of the lake basins indicates that the sodium concentration and not the sulfate concentration probably was the critical factor for the occurrence of the bedded sodium sulfates. Various evidence indicates that the sodium sulfates were deposited by supersaturation during a severe short-term cold snap. It appears that the Ogallala aquifer down-slope (SE) from every one of the large pluvial lake basins has been contaminated by the saline lake waters or the saline lacustrine deposits. This has severe ramifications with respect to the plan to import water to the southern High Plains for municipal water and to insure continuation of irrigated agriculture. It appears that any current water storage plan would result in contamination by salts from the large pluvial basins. (See also W72-01749) (Casey-Arizona)
W72-01752

MEASUREMENT AND ANALYSIS OF UNSATURATED FLOW AND GROUNDWATER SURFACE PROFILES RELATED TO RECHARGE AND WITHDRAWALS,

Arizona Univ., Tucson.

D. D. Evans, W. G. Matlock, H. K. Qashu, J. S. Sumner, and A. W. Warrick.
Available from the National Technical Information Service as PB-204 708, \$3.00 in paper copy, \$0.95 in microfiche. Arizona University Project Completion Report, August 1971. 29 p, 7 fig, 2 tab, 4 ref. OWRR A-017-ARIZ (1).

Descriptors: *Surface-groundwater relationships, *Ephemeral streams, *Water wells, *Water level fluctuations, *Arizona, Groundwater, Withdrawal, Groundwater recharge, Unsaturated flow, Groundwater movement, Mathematical models, Computer programs, Aquifer characteristics.

The relationship between time of flow in Rillito Creek, an ephemeral stream near Tucson, Arizona, and water levels in nearby wells was defined and a mathematical model of the underlying aquifer was formulated. A digital computer program was used to determine model parameter values which most closely duplicated measured groundwater surface profiles. Values obtained were: effective channel width, 150 feet; permeability, 0.0022 feet per second; porosity, 0.20; and infiltration, 3.8 feet per day. Computer water levels agreed closely with measured values for another recharge period. Field results show that the displacement of chloride applied in irrigation water can be quantitatively predicted by linking the equations of solute and water movement through an unsaturated soil. Geophysical methods were examined for determining groundwater volumes in alluvial basins and coefficients of storage. Correlation of gravity changes with coefficient of storage indicates that the gravity method may be used for aquifers which have high coefficients of storage and in which the water table rises or declines 20 feet or more. (Woodard-USGS)
W72-01781

NONLINEAR DUPUIT EQUATIONS FOR THE PHREATIC SURFACE OF A SEMI-INFINITE AQUIFER,

Wisconsin Univ., Milwaukee. Dept. of Physics.

I. Gyuk and R. Williams.

Water Resources Bulletin, Vol 7, No 5, p 969-980, October 1971. 7 fig, 1 tab, 3 ref.

Descriptors: *Dupuit-Forchheimer theory, *Equations, *Computer programs, *Groundwater movement, *Numerical analysis, Drawdown, Water levels, Infiltration, Percolation, Linear programming.

In a new approach to the nonlinear equations for the phreatic surface of groundwater flow from or into a reservoir, the differential equation is converted into an equivalent integral equation, which is then solved by a method of iteration. Exact results can be obtained for both drawdown and infiltration, including the special case of groundwater penetration into dry soil. The integrations involved are of very simple type and computer calculations are straightforward. (Knapp-USGS)
W72-02004

OVERPUMPED ARTESIAN WELLS AMONG A WELL GROUP,

North Carolina State Univ., Raleigh. Dept. of Civil Engineering.

For primary bibliographic entry see Field 04B.
W72-02005

GEOCHEMICAL INTERPRETATIONS OF GROUNDWATER FLOW SYSTEMS,

Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02K.
W72-02007

AN ALGORITHM FOR LEAST SQUARES ANALYSIS OF DRAWDOWN IN OBSERVATION WELLS,

Research Council of Alberta, Edmonton.

For primary bibliographic entry see Field 04B.
W72-02008

CONCENTRATION GRADIENTS IN AQUIFERS,

Tulsa Univ., Okla.

M. K. Kemp.

Oklahoma State University, Water Resources Research Institute, Research Project Technical Completion Report, 1971. 7 p, 2 fig, 1 tab, 2 ref.

OWRR A-025-OKLA (1).

Descriptors: *Thermal properties, *Aquifers, *Pumping, *Groundwater, *Oklahoma, Electrolytes, Clays, Membranes, Analytical techniques, Brines.

Identifiers: *Thermal pumping, Thermal dynamics.

WATER CYCLE—Field 02

Water in Soils—Group 2G

served in the groundwater of sod-podzolic soil when the water table was at a depth of 450 cm.—Copyright 1971, Biological Abstracts, Inc. W72-01733

SIGNIFICANCE OF SURFACE RUNOFF IN THE WATER REGIME OF DRAINED SOIL, (IN RUSSIAN),
R. A. Tumas.
Nauch Tr Litov Sel'Skokhoz Akad. 14 (5): 27-31. 1968.
Identifiers: Coefficient, Drained, Filtration, Regime, Runoff, Soil, Surface.

Water balance of drained sod-gley podzolized loamy soils was studied. The intervals between the drains were 10, 16 and 22 m, the drains were placed at depths of 0.8, 1.10 and 1.40 m, and the mean surface gradient of the plot was 0.008. The filtration coefficient was 0.3-0.4 m/day down to depth of 0.5 m and 0.005-0.01 m/day lower down. Drainage runoff in the different drainage variants are given. The formation of drainage runoff was affected by the redistribution of snow reserves under the influence of surface runoff. The drainage did not insure complete removal of meltwater. Formation of surface runoff during the warm season is expected to occur once in 10 yr. If the water table reaches the soil surface, atmospheric precipitation creates surface runoff irrespective of the amount of precipitation. Elimination of surface runoff causes the top water to leave the arable layer 0.5-1.5 day early.—Copyright 1971, Biological Abstracts, Inc. W72-01734

FERTILITY STUDIES OF PASTURE SOILS IN THE WET TROPICAL COAST OF QUEENSLAND: I. SOIL-VEGETATION CLASSIFICATION UNITS,
Department of Primary Industries, South Johnston (Australia). Research Station.
For primary bibliographic entry see Field 03F. W72-01737

SOIL MOISTURE SURVEY, 1970-1971.
High Plains Underground Water Conservation District No. 1, Lubbock, Tex.

The Cross Section, February 1971, Vol. 17, No. 2 p. 8. 1 tab, 1 fig. 1 ref.

Descriptors: *Soil moisture, *Moisture availability, *Surveys, *Great Plains, *Precipitation (Atmospheric), Texas, Rainfall, Droughts, Water requirements, Water wells, Well permits, Soil physical properties, Field capacity, Irrigation efficiency, Crop production, Water storage, Irrigation practices, Probability.

Report is in response to lack of precipitation in the High Plains, increase in activity to supplement water requirements, deepening of existing wells, increase in well-permit applications, and increase in pre-plant irrigation in the Texas High Plains. Moisture values for the first 5 feet of soil depth give a true picture of holding capacity of soil. There is a maximum moisture holding capacity for soils, and beyond this capacity, additional water is not effectively used. A man of moisture needed to saturate 5 feet of soil in the Southern High Plains is presented. Other factors for optimum irrigation efficiency and crop production include deep soil water storage, irrigation schedule, pre-irrigation, and probability of spring rains. A percent-probability-for-rainfall table is shown for 1.0 to 4.0 inches and 5 time intervals. The moisture survey covers 114 points in 14 counties (14,000 square miles). (Popkin-Arizona) W72-01744

SOME GEOGRAPHIC IMPLICATIONS OF WATER-REPELLENT SOILS,
Montana Univ., Missoula, and Forest Service, Berkeley, Calif.
G. T. Foggan and L. F. DeBano.
Professional Geographer, Vol. 23, No. 4, p. 347-350, October 1971. 3 fig, 14 ref.

Descriptors: *Soil physical properties, *Vegetation effects, *Soil water movement, *Infiltration, *Geographical regions, Geomorphology, Burning, Agriculture, Runoff, Soil profiles, Watershed management, Evaporation.
Identifiers: *Water-repellent soils, *Pedogenesis.

Water infiltration and movement within a water-repellent soil differs considerably from that of a wettable soil. Such repellency can be produced by attaching a hydrophobic organic coating to the soil particles. The chemical nature of the organic coating (s) has not yet been identified. Water repellency reduces evaporation from soils by reducing capillary movement and creating a thin dry surface layer, preventing diffusion to and from deeper soil layers. It is argued that while the ramifications of this phenomenon have received much attention from a number of disciplines, it has been virtually ignored by geography and its allied fields. The distribution and intensity of water repellency is strongly related to plant distribution and to soil texture. However, broader global distributions of water repellency are unknown, although it has been reported from regions of the U.S., western Africa, western Europe, Israel, New Zealand, and Australia. The effects of fire on water repellency and the effects of water repellency on pedogenesis, geomorphology, and agriculture are briefly discussed. (Casey-Arizona) W72-01745

TIME IN TRANSIT OF WATER MOVING VERTICALLY FOR GROUND WATER RECHARGE,
Arizona Univ., Tucson. Dept. of Agricultural Chemistry and Soils.

D. C. Evans, and A. W. Warrick.
In: Saline Water, Mattox, R. B. (ed.), AAAS, Committee on Desert and Arid Zone Research, Contribution No. 13, p. 87-97, 1970. 6 fig, 1 tab, 10 ref.

Descriptors: *Soil water movement, *Hydraulic conductivity, *Subsurface flow, *Theoretical analysis, Darcy's Law, Volumetric analysis, Groundwater recharge, Groundwater movement, Infiltration, Porous media, Soil profiles, Pressure head, Root zone, Variability.

When considering the water budget for, and area of, the downward movement of various chemical or biological constituents of water, characteristics of water percolating downward through soil must be understood. Under irrigated conditions, the question arises as to the fate of the water which gets below the root zone. The initial and boundary conditions will determine the rate of downward movement of water through soil with specific transport characteristics, and the amount reaching the water table should be determined by the input rate. Starting with Darcy type equations for vertical flow, the questions of the rate of water movement to deep depths if the input rate is constant over a long period of time and the rate of movement and dissipation of water content 'bulges' formed when water is applied on a periodic basis, are considered. Plotting the average velocity for a given input rate vs. the volumetric flux corresponding to the hydraulic conductivity, it was seen that the hydraulic conductivity of various soils varies over several orders of magnitude while the volumetric water content varies only from about 0.15 to 0.45 cu cm/cu cm and the variability among soils therefore appears small. However the average velocities obtained from the curves may be in error by as much as 50%. The information presented indicates that long times of travel may be involved if the input rates are on the order of cm/year, conditions which certainly occur in arid zones without irrigation. (See also W72-01749) (Casey-Arizona) W72-01750

LONG TERM MOVEMENT OF WATER AND SOIL SALINITY IN THE WEATHERING ZONE OF ARID ZONE SEDIMENTS,
New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry.
J. A. Schufle.

In: Saline Water, Mattox, R. B. (ed.), AAAS, Committee on Desert and Arid Zone Research, Contribution No. 13, p 46-56, 1970. 6 fig, 10 ref.

Descriptors: *Soil water movement, *Ion exchange, *Saline soils, *Unsaturated flow, *Water table, Groundwater, Groundwater movement, Infiltration, Porosity, Soil Moisture, Soil properties, Terraces (Geological), Sediments, Sodium, Potassium, Precipitation (Atmospheric), Aging (Physical), Arid lands.
Identifiers: *Exchangeable cations.

Most authorities have agreed that additions to groundwater, in arid regions, are, at most, only a few percent of the precipitation. The question then arises as to whether or not the water then moves downward through the weathering zone. Ground water salinities would have to approach 30% for sealing off to occur, and soil analyses indicate this is rarely the case. It is argued, that in approaching problems of soil water movement the movement of accompanying exchangeable cations may be interpreted in terms of the movement of ions on an ion exchange column. The ion exchange characteristics of a soil may be expressed in terms of a distribution coefficient (K), which is the ratio of cation wt/g of soil to cation wt/ml of solution. Experimentally determined K's of soil sodium and soil potassium are both about 30 ml/g. Analysis of soil profiles from Rio Grande Terraces indicate that ion exchange ages for Sodium are about 170 years for the youngest sediments. Absolute ages of the sediments were determined by the C-14 method, and ratios of the 2 ages, called dating factors (f), were determined. The f value averages 7, which is equivalent to about 10% of the precipitation penetrating the soil and reaching the water table, a much higher value than previously thought. It is speculated that absorbed water layers move slowly, but effectively, downward through unsaturated soil under the force of gravity, ultimately resulting in large ground deposits. (See also W72-01749) (Casey-Arizona) W72-01753

FERTILITY STUDIES OF PASTURE SOILS IN THE WET TROPICAL COAST OF QUEENSLAND: II. GRANITIC SOILS,
Department of Primary Industries, South Johnstone (Australia). Research Station.
For primary bibliographic entry see Field 03F. W72-01767

SORPTION AND DESORPTION OF CHLORINATED HYDROCARBON PESTICIDES IN AQUATIC SEDIMENT MINERALS,
Missouri Univ., Rolla. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B. W72-01779

DYNAMIC SIMULATION OF VERTICAL INFILTRATION INTO UNSATURATED SOILS,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
S. I. Bhuiyan, E. A. Hiler, C. H. M. van Bavel, and A. R. Aston.
Available from the National Technical Information Service as PB-204 709, \$3.00 in paper copy, \$0.95 in microfiche. Water Resources Institute Research Report, (1971). 23 p, 8 fig, 15 ref. OWRR B-080-TEX (2).

Descriptors: *Soil water movement, *Infiltration, *Unsaturated flow, *Soil properties, *Computer models, Darcys law, Systems analysis, Mathematical models, Numerical analysis, Transmissivity, Diffusivity, Porous media, Input-output analysis.
Identifiers: *Unsaturated soils, Vertical infiltration.

A dynamic simulation language (S/360 CSMP) was used to develop a computer model which simulated vertical infiltration of water into unsaturated soil. The modeling concept consisted primarily of dividing the soil into a large number of layers of equal thickness. The net flux of water through each layer

Field 02—WATER CYCLE

Group 2G—Water in Soils

at any particular time was established using the principles of conservation of mass and Darcy's law. The ensuing water content was then calculated by integrating the net flux utilizing the fourth order Runge-Kutta method with suitable error criteria. The cumulative infiltration was calculated from the instantaneous infiltration rates using the same integration technique. Water content profiles with time were obtained for three different soils: Yolo light clay, Adelanto loam and Pachappa loam. The infiltration rate and cumulative amount were also calculated with time giving a complete picture of the water intake characteristics of the soil. (Woodard-USGS) W72-01782

SOIL SUITABILITY FOR EUCALYPTUS HYBRID (SYNONYM E. TERETICORNIS OR MYSORE GUM) PLANTATIONS IN TARAT AND BHABAR REGION OF UTTAR PRADESH, Central Soil Salinity Research Inst., Karnal (India). J. S. P. Yadav, and Jai Prakash.

Indian Forest. 95 (12): 834-840. Illus. 1969. Identifiers: Aeration, Bhabar, Drainage, Eucalyptus-D, Eucalyptus-Tereticornis-D, Gum, Hybrid, India, Moisture, Mysore, Plantations, Soil, Synonym, Tarai, Texture, Uttar-Pradesh.

Soil texture, stoniness, drainage moisture regime and aeration greatly influenced growth. Bhabar soil with coarse texture and deficient moisture is not so favorable as bhabar soil of silty loam with a higher water table. Tarai soil without stones but with adequate moisture and satisfactory drainage provides a better environment. Calcareous soil with alkaline reaction and diffuse lime nodules does not appear harmful.—Copyright 1971, Biological Abstracts, Inc. W72-01904

PATTERN AND SEASONAL VARIABILITY IN THE ENVIRONMENT OF A SCOTS PINE FOREST SOIL, Edinburgh Univ. (Scotland). Dept. of Forestry and Natural Resources. M. B. Usher.

J Ecol. 58 (3): 669-679. Illus. 1970. Identifiers: Environment, Forest, Pattern, Pine-G, Scotland, Scots, Seasonal, Soil, Variability.

Methods of sampling and analysis are described which were planned to investigate the water content, pore space, and N, P, K, and Ca concentrations of the forest soil. The results are based on the analysis of 1152 small, contiguous samples taken from the litter and fermentation horizons of a humus Fe podzol in Perthshire, Scotland. The water content had a distinct seasonal fluctuation, and a pattern of randomly distributed wet and dry samples in the surface layer and gradients deeper in the profile is shown. The pore space had a winter maximum but shows no pattern of distinction. N concentration gradually increased during the summer and shows a pattern of randomly scattered areas of high concentration. The K and P concentrations show no seasonal variability, but P gradients and small patches of high K concentration are demonstrated. The Ca concentration was intermediate in pattern between P and K. The different manifestations of pattern, or 'concentration aggregation,' are considered to show a series of aggregation sizes ranging from small (N, less than 16 ml) to large (P, in the order of 750 ml). Samples for survey work should be taken in the spring or early autumn, at a standard distance from trees, and should be cores of more than 13 cm diameter.—Copyright 1971, Biological Abstracts, Inc. W72-01906

SOIL PROCESSES IN SECONDARY SOD-PODZOLIC SOILS ON THE SHORES OF RYBINSK RESERVOIR UPON THEIR UNDERFLOODING, (IN RUSSIAN), L. V. Yakovleva.

Tr Darvinskogo Gos Zapovednika. 9. 267-304. 1968.

Identifiers: Chemical, Flooding, Formation, Physical, Podzolic, Processes, Reservoir, Rybinsk, Shores, Sod, Soil, Soils, USSR, Vegetation.

Underflooding caused a rise of water tables; the soils became appreciably gleyed and the vegetation changed from zerophytes to paludine forms. The general trend of soil formation on the underflooded territory was first toward the meadow process, then to bogging. As gleyization proceeded there were appreciable changes in soil texture and hydrophysical properties. The clay fraction content, density and moisture content of soils increased, while their porosity and water permeability decreased. The humus content increased from 1.2 to 3%, and the ratio Chum/Cfulv became smaller. The soils developed acid reaction, pH H₂O 4.2-5.6. Horizon B exhibited the appearance of exchangeable Al and increased exchange acidity (0.5-1.5 meq/100 g soil in the horizon A). Absorbed H was 25-50% of total absorbed bases. The FeO content in horizon A of strongly gleyed soils was 40-60 mg, and 9.30 mg FeO in horizon B. The characteristic values of redox potential were 655-545 mV for weakly gleyed soils, 610-430 mV for medium-gleyed soils and 200-400 mV for strongly gleyed soils. The phase of strong gleyization of secondary sod weakly podzolic soils represents the start of bogging.—Copyright 1971, Biological Abstracts, Inc. W72-01944

PROMOTION OF THE DEGREE OF REDUCTION IN SOIL BY FLOODING, Institute for Soil Fertility, Haren-Groningen (Netherlands).

G. W. Harmsen. Plant Soil. 34 (1): 237-240. 1971. Identifiers: Degree, Flooding, Reduction, Soil.

Very low oxidation-reduction potentials were found in flooded soils. These potentials were hardly buffered in mechanically undisturbed soils, whereas any type of uprooting brought about the formation of oxidizable matter and stabilized the low level of the potential.—Copyright 1971, Biological Abstracts, Inc. W72-01968

EFFECT OF DIFFERENT DEGREES OF SOIL MOISTURE UPON GROWTH YIELDS AND FLORISTIC CHANGES OF THE COMMON MATGRASS (NARDUS STRICTA L.) COMMUNITY (IN POLISH), Instytut Melioracji i Uzyskow Zielonych, Krakow (Poland). Zakkad Przyrod. Podstawa Melioracji. Ryszard Kostuch.

Rocznik Nauk Roln Ser F Melioracji Uzyskow Zielonych. 77 (2): 213-219. Illus. 1969. English summary.

Identifiers: Agrostis-Vulgaris-M, Bryum-Sp, Community, Degrees, Floristic, Grass-M, Growth, Hieracium-Pilosella-D, Juncus-Articulatus-M, Juncus-Buffonius-M, Juncus-Squarrosum-M, Mat, Mnium-Sp, Moisture, Nardus-Stricta-M, Poa-Pratensis-Var-Angustifolia-M, Rhytidadelphus-Squarrosum, Soil, Yields.

Best growth was at a soil moisture content of 60%. On dry soil (30%) the matgrass community is quickly suppressed by other species, such as common bentgrass (*Agrostis vulgaris*), narrow-leaved meadow bluegrass (*Poa pratensis* var. *angustifolia*) and autumnal hawkweed (*Hieracium pilosella*). On wet soil (90%) the matgrass was quickly replaced by hygrophytic species, mainly rushes (*Juncus buffonius*, *J. articulatus*, *J. squarrosum*) and brown mosses: *Bryum* sp., *Mnium* sp. and *Rhytidadelphus squarrosum*. The matgrass growth period was longer in soil with higher moisture content. Hay from plants grown in soil with low moisture content had a high crude protein content. The transpiration coefficient increased with decreasing soil moisture content.—Copyright 1971, Biological Abstracts, Inc. W72-01972

SOME EXACT SOLUTIONS TO THE EQUATIONS DESCRIBING AN IDEAL-FLUID THERMOCLINE, Goteborg Univ. (Sweden). Inst. of Oceanography. P. Welander.

Journal of Marine Research, Vol 29, No 2, p 60-68, May 15, 1971. 2 fig, 8 ref, append.

Descriptors: *Thermocline, *Sea water, Water temperature, Thermal stratification, Mathematical models, Equations, Oceans, Salinity, Density. Identifiers: Ideal fluids.

The equations that describe a steady ideal-fluid motion have a first integral that express a functional relationship between the potential vorticity, the density, and the Bernoulli function. By using this relationship, solutions to the ideal-fluid-thermocline may be obtained. When an exact solution is fitted to observed surface data, it gives a realistic meridional-density field: an inflection point in the density profile, a sharp thermocline at finite depth at the equator, and a reversal of the meridional-density gradient at a subtropical latitude. Without a direct estimate of the diffusive scale depth in the oceans, the idea of an ideal-fluid thermocline must be taken seriously. (Knapp-USGS) W72-02032

NATURAL MOISTURE CONDITIONS OF THE OB BASIN AND PROSPECTS OF WATER DEVELOPMENT (YESTESTVENNYYE USLOVIYA UVLAZHNENIYA TERRITORII OB-SKOGO BASSEYNA I PERSPEKTIIV GIDROMELIORATSIY), Omkii Selskokhozyaistvennyi Institut (USSR).

For primary bibliographic entry see Field 04A. W72-02063

INVESTIGATIONS OF MOISTURE EXCHANGE IN THE ZONE OF AERATION IN IRRIGATED LAND (ISSLEDOVANIYA VLAGOZOMBENI V ZONE AERATSIII NA OROSHAYEMYKH ZEMLYAKH), Gosudarstvennyi Gidrologicheskii Institut, Lenigrad (USSR). For primary bibliographic entry see Field 04A. W72-02070

INERTIAL FORECAST OF WATER STORAGE IN SOIL AND ITS ECONOMIC EFFECTIVENESS (INERTSIONNYY PROGNOZ POCHVENNYX VLAGOZAPASOV I VEGO EKONOMICHESKAYA EFFEKTIVNOST'), A. P. Fedoseev. Meteorologiya i Gidrologiya, No 6, p 111-120, June 1971. 3 fig, 5 tab, 13 ref.

Descriptors: *Evaluation, *Economic prediction, *Economic efficiency, *Monetary benefits, *Forecasting, Probability, Water storage, Precipitation (Atmospheric), Soil moisture, Soils, Fertilizers, Agronomic crops, Barley, Plant growth, Crop response. Identifiers: *USSR, Agrometeorology, Top-dressing.

The probability of an increase or decrease from the initial water storage in soil under summer crops (inertial) was examined to develop a method of making an agrometeorological forecast to justify the application of mineral topdressing to barley and of validating its economic effectiveness. The average economic effectiveness of an annual automatic application of mineral topdressing without any forecast is 6.86 rubles per hectare of cropland. The economic effectiveness of an application of topdressing to barley with an inertial forecast of the soil-moisture level in the second half of a growing period is 12.14 rubles per hectare. Consideration of a 2-month synoptic forecast of precipitation as a supplement to the inertial forecast increases the economic effectiveness of topdressing application to 14.52 rubles per hectare. Excluding the 2-month synoptic forecast, the effectiveness of the agrometeorological forecast is 5.28 rubles per hectare.

WATER CYCLE—Field 02

Lakes—Group 2H

tare. Assuming that about 80% of the crops are in need of mineral topdressing and that no more than 40% of the farms can be initially included in a topdressing program, the total economic effectiveness of the use of an agrometeorological forecast to justify a mineral topdressing for early summer crops in the central nonchernozem zone will be 4.1 million rubles a year. (Josefson-USGS)
W72-02095

RESPONSE BY IRRIGATED GRAIN SORGHUM TO BROADCAST GYPSUM AND PHOSPHOROUS ON HEAVY CLAY SOIL, Commonwealth Scientific and Industrial Research Organization, Deniliquin (Australia). Div. of Plant Industry.

For primary bibliographic entry see Field 03F.

W72-02117

SOIL MOISTURE AS AFFECTING CERTAIN PHYSIOLOGO-BIOCHEMICAL PROCESSES IN WINTER WHEAT DURING THE AUTUMN-WINTER PERIOD, (IN RUSSIAN), Bulgarian Academy of Sciences, Sofia. Inst. of Genetics and Selection of Plants.

For primary bibliographic entry see Field 03F.

W72-02168

BLUE-GREEN ALgal EFFECTS ON SOME HYDROLOGIC PROCESSES AT THE SOIL SURFACE, Arizona Univ., Tucson. Water Resources Research Center.

W. F. Faust.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 99-105, 1971. 1 fig, 2 tab, 4 ref.

Descriptors: *Soil algae, *Soil surfaces, *Sediment yield, *Simulated rainfall, *Soil types, Soil texture, Clays, Laboratory tests, Statistical methods, Soil microorganisms, Runoff, Hydrologic data. Identifiers: *Suspended sediment production, *Blue-green algae.

Previous studies have indicated that blue-green algae may affect runoff, infiltration and erosion at soil surfaces. Using soil plots upon which blue-green algae were grown under an artificial wetting regime, studies were made using simulated rainfall. A 30% clay content Pima soil and a contrasting 8% clay content river-bottom Anthony soil were used. *Syctonema hoffmanni* and *Microcoleus vaginatus* grew on the Pima soil while *Schizothrix calcicola* developed on the Anthony soil. The results showed that blue-green algal growths significantly reduced the amount of suspended soil material in runoff water as compared with bare soils. Differences in runoff suspended sediments were also related to differences in soil type and simulated rainfall intensity. An analysis of variance of the effects of these 3 factors and their interactions showed that the smaller differences in suspended sediment production on the Anthony soil due to the microvegetation treatment was verified by a highly significant soils-microvegetation interaction, probably because the finer Pima soils wash away more easily without stabilizing microvegetation. Also, less vegetation seems to grow on the Anthony soil. Differences in runoff and infiltration volumes and in settleable sediment amounts were not detected. (See also W72-02212) (Casey-Arizona)
W72-02218

EFFECTS OF FIRE ON WATER INFILTRATION RATES IN A PONDEROSA PINE STAND, Arizona Univ., Tucson. M. J. Zwolinski.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Sciences,

April 22-23, 1971, Tempe, Vol 1, p 107-112, 1971. 2 ref.

Descriptors: *Burning, *Infiltration, *Soil chemical properties, *Forest soils, *Watersheds, Ponderosa pine trees, Arizona, Infiltrometers, Soil temperature, Overwintering sites, Frost action, Soil texture, Porosity, Forest fires, Forest management.

Identifiers: *Water repellent soils.

The importance of pine forest as a timber and water producing area has led to intensive management, including protection from wildfire. This has resulted in dense stand growth with increased destructive fire potential and transpiration water loss. In Arizona, as in many areas, prescribed forest burning has been used to effectively reduce these fuel hazards. Some question has arisen about the possible side effects of such treatments, particularly air pollution and reduction of infiltration and water yield. In an effort to determine the effects on infiltration, plots receiving various treatments (control, light burn, heavy burn) were fitted with fusion pyrometers before burning, to measure soil surface temperatures during burning. After burning, infiltrometers were installed. Surface temperatures did not exceed 200 degrees F. for the light burns, and ranged over 350-500 degrees F. during heavy burns. Both heavy and light burns produced highly significant decreases in infiltration capacities after burning and the surface 2 inches showed increases in soil pH, carbon and total nitrogen percentages. Infiltration capacities returned to normal after overwintering and were attributed to frost action on soil texture and porosity. The soil chemical changes decreased slowly over 2 years. Soil water repellency also increased and the significance of this is discussed. (See also W72-02212) (Casey-Arizona)
W72-02219

THE USE OF A REALISTIC RAINFALL SIMULATOR TO DETERMINE RELATIVE INFILTRATION RATES OF CONTRIBUTING WATERSHEDS TO THE LOWER GILA BELOW PAINTED ROCK DAM, Arizona Univ., Tucson. Water Resources Research Center.

C. B. Cluff, and D. G. Boyer.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 113-131, 1971. 3 fig, 3 tab, 10 ref.

Descriptors: *Rainfall simulators, *Infiltration, *Rainfall-runoff relationships, *Watersheds, *Arid lands, Arizona, River basins, Soil types, Floodways, Flood forecasting, Rainfall.

The Rotadisk Rainulator is a recently developed rainfall simulator utilizing a full-cone-spray type nozzle. Its unique feature is the rotation of disks of various size openings that makes it possible to produce intensities from close to zero up to full nozzle capacity. Disks may be quickly changed, making it possible to study the effects of various intensities on infiltration rates, such as occur in natural storms. For all intensities above 1.0 in/hr, the instrument comes closer to duplicating kinetic energies and momenta of natural rainfall than any other type of rainfall simulator. Little rainfall-runoff data are available on most of the lower Gila watersheds. Infiltration rates were therefore determined using the Rotadisk Rainulator on recompacted soil samples from the watershed. The results permitted a ranking of the watersheds on the basis of infiltration rates, which supports an independent flood frequency analysis indicating that the flood threat from subwatersheds along the Gila is much lower than had previously been projected. When the instrument is taken into the field, it should be possible to directly determine the infiltration rates of different soil and vegetation types, which will be of more use to hydrologists than data from recompacted samples. (See also W72-02212) (Casey-Arizona)
W72-02220

FIELD MEASUREMENTS OF SOIL-WATER CONTENT AND SOIL-WATER PRESSURE, Agricultural Research, Phoenix, Ariz. Water Conservation Lab.

R. J. Reginato, and R. D. Jackson.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 143-151, 1971. 2 fig, 4 ref.

Descriptors: *Soil moisture, *Soil profiles, *Water pressure, *Measurement, Tensiometers, On-site data collections, Hysteresis, Gamma rays, Soil temperature.

Identifiers: *Soil moisture tension.

Knowledge of the dynamic water content-pressure potential relationship within the soil profile is useful in determining the importance of hysteresis under natural conditions. Continuous monitoring of water content in the field is now possible using recently developed gamma-ray transmission equipment which allows water content measurements in 1 cm-thick soil layers with an error of 0.0009 gm/gm. The nuclear equipment and the tensiometer assembly for pressure measurements are described. Soil water content and pressure in the top 10 cm of a field soil profile were measured continuously for a 2-week period following an irrigation. The highest water content was measured each day just before sunrise. This declined rapidly from early morning to early afternoon, and was followed by a gain during the mid-afternoon and evening. The amplitude of this diurnal change diminished with time after irrigation. The pressure potential at a depth of 1.5 cm decreased most rapidly as the water content declined, but not exactly in phase. This may have been due to temperature effects on the pressure metering system. A moisture characteristic curve was constructed from the data. (See also W72-02212) (Casey-Arizona)
W72-02222

RUNOFF AND SOIL LOSS ON A SAND VELD IN RHODESIA, D. L. Barnes, and M. J. Franklin.

Proc Grassl Soc S Afr. 5: 1970, 140-144. Identifiers: Chemical, Loss, Physical, Rhodesia, Runoff, Sand, Soil, Veld.
W72-02240

2H. Lakes

CONTROL OF BENTHIC DEPOSITS IN LAKES, Massachusetts Univ., Amherst. Dept. of Civil Engineering.

T. H. Feng, J. M. Colonell, F. A. DiGiano, H. C. Hyde, and A. P. Asikainen. Available from the National Technical Information Service as PB-204 895, \$3.00 in paper copy, \$0.95 in microfiche. Massachusetts University Water Resources Research Center Publication No 16, July 1971. 194 p, 209 ref, 4 append. OWRR-B-005-MASS (1).

Descriptors: *Benthos, *Lakes, *Water quality control, *Nutrients, *Bottom sediments, Plants, Vegetation, Laboratory tests, Mathematical models, Sedimentation, Reviews, Sediment transport.

Studies of benthic deposits in lakes are divided into four parts: (1) Sediment-water interchange of plant nutrients in lakes - the data were the results of laboratory experiments conducted in sediment-water contact columns. The interchange of chemical constituents took place within the first month after the contact of sediment with water. Mixing of the water at an energy level of 0.0096 hp per million gallons of water greatly increased the dissolved oxygen concentration. While the mixing had no significant effects on nitrogen interchange, it suppressed phosphorus and iron in the overlying water. (2) Mathematical modeling of nutrient-transport - a mathematical model was proposed to describe

Field 02—WATER CYCLE

Group 2H—Lakes

quantitative relationships between the extent and rate of nutrients release from sediments and the characteristics of sediment-water systems. (3) A preliminary study on the utilization of laminar jet flows for removal of benthic deposit - laminar jet flows were developed in a laboratory flume, which scoured and transported sediments of specific gravity as high as 1.91. (4) Literature review - the literature on bottom deposits are reviewed for 1967, 1968 and 1969. (Woodard-USGS).
W72-01699

HYDROLOGIC FACTORS IN THE DETERMINATION OF WATERSHED YIELDS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W72-01700

THE DIVERSITY OF PIGMENTS IN LAKE SEDIMENTS AND ITS ECOLOGICAL SIGNIFICANCE,
Minnesota Univ., Minneapolis. Dept. of Botany.
For primary bibliographic entry see Field 05C.
W72-01784

THE LAKE AS A MICROCOOSM,
Illinois State Natural History Survey, Peoria.
For primary bibliographic entry see Field 05C.
W72-01787

SUGGESTED CLASSIFICATION OF ALGAE AND PROTOZOA IN SANITARY SCIENCE,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Interference Organisms Studies and Water Supply and Water Pollution Control Research.
For primary bibliographic entry see Field 05C.
W72-01788

DISSOLVED OXYGEN VARIATIONS IN STRATIFIED LAKES,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 05C.
W72-01864

THE GROWTH OF BROWN TROUT SALMO TRUTTA L. IN NORTHERN SCOTTISH LOCHS WITH SPECIAL REFERENCE TO THE IMPROVEMENT OF FISHERIES,
Nature Conservancy, Edinburgh (Scotland).
R. N. Campbell.
J Fish Biol. 3 (1): 1-28. Illus. 1971.
Identifiers: Brown, Density, Fisheries, Growth, Lochs, Northern, Population, Salmo-Trutta, Scottish, Trout.

This paper is based on the investigation of 173 lochs in Scotland from which a total of over 4700 brown trout were examined. Twenty-four of the lochs, all in northern Scotland, and their trout populations, are selected for detailed comparison in an attempt to identify environmental factors that might affect the growth rate of trout. The lochs probably represented the full range of main standing water habitats in the region-ranging from a saline loch in the Outer Hebrides to one in a subarctic environment high on the Cairngorm plateau in the Central Highlands. The study indicates that for practical purposes the growth rate of trout is negatively correlated with population density. Some suggestions for improving brown trout lochs, based on the findings of this paper, are included.—Copyright 1971, Biological Abstracts, Inc.
W72-01915

THE AGE AND GROWTH OF PERCH (PERCA FLUVIATILIS L.) IN TWO SCOTTISH LOCHS,
Glasgow Univ. (Scotland). Dept. of Zoology.
Muhammed Shafi, and Peter S. Maitland.
J Fish Biol. 3 (1): 39-57. Illus. 1971.
Identifiers: Age, Growth, Lochs, Perca-Fluviatilis, Perch, Scottish.

This study is concerned with the age and growth of (*P. fluviatilis*) in 2 contrasting Scottish lochs—the Dubh Lochan and Loch Lomond. Age and back-calculated growth were determined from annual rings in the opercular bones, and during the 2-yr project 470 perch from the Dubh Lochan and 796 from Loch Lomond were examined. Growth in length in the 2 lochs, though similar for the 1st 2 yr, differed thereafter, the average length at 8 yr in the Dubh Lochan being less than 15 cm, that in Loch Lomond more than 23 cm at the same age. In neither locality did the growth of perch follow the Von Bertalanffy growth formula. Reasons for differential growth rates are discussed and comparisons made with the growth of perch in other waters in Europe and North America.—Copyright 1971, Biological Abstracts, Inc.
W72-01916

UPSTREAM MOVEMENTS OF BENTHIC INVERTEBRATES IN A LAKE DISTRICT STREAM,
Freshwater Biological Association, Ambleside (England).
J. M. Elliott.
J Anim Ecol. 40 (1): 235-252. Illus. 1971.
Identifiers: *Baetis-rhodani*, Benthic, Coleoptera, Diptera, *Ephemerella-ignita*, *Gammareus-pulex*, Invertebrates, Lake, Movements, Plecoptera, Stream, Upstream.

Monthly samples of upstream-moving invertebrates were taken at 2 sites in the Wilfin Beck, a small stony stream in the English Lake District. A large number of invertebrates moved upstream into traps at both sites and were chiefly small nymphs of Plecoptera and Ephemeroptera, small larvae of Diptera, larvae of Coleoptera, and small individuals of *Gammareus pulex*. Large individuals were predominant in the catches of a few species of Trichoptera with case-building larvae, and *G. pulex* in spring. Case-building larvae of Trichoptera did not show a definite upstream movement. Most invertebrates moved upstream in the small stones and gravel near the banks. Large nymphs of *Baetis rhodani* were the only invertebrates to show greater upstream movement in midstream where the substratum was chiefly large stones. Other invertebrates, including large larvae (or nymphs) of Plecoptera, Ephemeroptera and Trichoptera, moved upstream in similar numbers at different points across the stream. More invertebrates moved upstream at night than during the day, and the catches of *B. rhodani* and *G. pulex* were large enough to show a definite diel periodicity in upstream movement with a distinct nocturnal peak. Measurements were made of the distances moved upstream by marked invertebrates or by invertebrates in a trough (20 spp. and 2 genera). There were significant correlations between modal values obtained in these experiments and indices of the rate of upstream movement into traps. All species moved further upstream at night than during the day, but high modal values were recorded during the day for some species, e.g. *B. rhodani* and *Ephemerella ignita*. Estimates were made of the total numbers of invertebrates moving upstream in 24 h, and ranged from 366 in Nov. to 1690 in April at one site. Upstream movement compensated for about 30% of the numbers of invertebrates drifting downstream in winter (upstream movement and drift at a minimal level), and for only 7-10% of the drift in spring and summer when both upstream movement and drift were high.—Copyright 1971, Biological Abstracts, Inc.
W72-01936

SOME PHYSICO-CHEMICAL INVESTIGATIONS OF STRATIFICATION IN ABBOT'S POOL, SOMERSET: THE DISTRIBUTION OF SOME DISSOLVED SUBSTANCES,
Bristol Univ. (England). Dept. of Botany.
Christina M. Happay.
J Ecol. 58 (3): 621-634. Illus. 1970.
Identifiers: Abbot's, Chemocline, Cycles, Dissolved, Distribution, England, Minerals, Physicochemical, Pool, Seasonal, Somerset, Stratification, Substances, Thermocline.

Distribution of nitrate, ammonia, inorganic phosphate and dissolved silica are not homogeneous down the depth profile throughout the year. Distinct seasonal cycles occur; ammonia, phosphate and silica accumulate in the hypolimnia during conditions of thermal stratification, whereas the content of nitrate decreases in the O2 deficient deeper water in summer. The autumn overturn and mixing of the water column are clearly demonstrated by the high levels of ammonia, phosphate and silica found throughout the water column in the autumn. The quantity of ammonia, phosphate and silica in the hypolimnia is sufficient to account for the high concentrations distributed throughout the pool in early Sept. The chemocline corresponds with the position of the thermocline and region of steepest O2 gradients which lie between 2 and 2.5 m. Larger quantities of dissolved substances can be released from the highly organic sediment experimentally than recorded in the hypolimnia. Values for A calculated from chemical data are less than those calculated from temperature gradients, suggesting that considerable diffusion and biological uptake may occur from the small hypolimnia into the larger epilimnia. Large amounts of dissolved substances are recycled in the pool and the inflow may be less important in the provision of nutrients than initially thought. Chemical cycles in Abbot's Pool are more complex than its dimensions would suggest, and parallel those found in larger and considerably deeper lakes.—Copyright 1971, Biological Abstracts, Inc.
W72-01937

SOLUBLE CARBOHYDRATES AS A FACTOR INFLUENCING GROSS PRIMARY PRODUCTIVITY AND BACTERIAL POPULATIONS IN LAKES,
Arizona Cooperative Fishery Unit, Tucson.
George F. Adams.
J Ariz Acad Sci. 6 (1): 71-77. Illus. 1970.
Identifiers: Algae, Bacterial, Carbohydrates, Factor, Gross, Lakes, Photosynthesis, Phyto, Plankton, Populations, Primary, Productivity, Soluble.

Three experiments in 120,006 acre tanks were performed to evaluate the effects crude beet molasses and crystalline corn dextrose additions might have on gross primary productivity and bacterial abundance. Significantly greater phytoplankton biomass, corresponding to carbohydrate additions at warmer water temperatures indicate utilization of carbohydrates as a source of energy by algae. Increased CO2 concentrations incident to bacterial metabolism may also have been responsible for additional photosynthetic capacity. Carbohydrate additions increased bacterial numbers. Evidence was found from plate counts, increases in maximum H ion concentration, and possibly from significantly greater turbidity found in tanks receiving the heavier concentration of carbohydrates. Significant increases in gross photosynthesis could possibly be produced at a cost of 11 1/2 cents per acre per day. This cost is not economical in lakes where biogenic salt fertilizations are effective.—Copyright 1971, Biological Abstracts, Inc.
W72-01938

SEASONAL DISTRIBUTION OF ZOOPLANKTON IN THE NORTHERN BASIN OF LAKE CHAD,
Virgin Islands National Park, St. John.
A. H. Robinson, and Patricia K. Robinson.
J Zool (London). 163 (1): 25-61. Illus. 1971.
Identifiers: Abundance, Basin, Chad, Crustacea, Distribution, Lake, Northern, Plankton, Rotifera, Seasonal, Zoo.

More than 300 pairs of fine and coarse mesh plankton net samples were collected in the northern basin of Lake Chad during an 18-mo. period, June 1967 to Nov. 1968. The seasonal distribution and abundance of the dominant species of Rotifera and Crustacea are given in addition to a general description of the hydrology and circulation of the northern basin of the lake. The composition and abundance of the zooplankton varied considerably

WATER CYCLE—Field 02

Lakes—Group 2H

over the sampling period; a generalized seasonal cycle is suggested. Synoptic estimates of absolute abundance are presented and compared to those in the southeastern portion of the lake.—Copyright 1971, Biological Abstracts, Inc.
W72-01942

THE INCIDENCE AND INTENSITY OF PREDATION ON LAKE-DWELLING TRICLADS IN THE FIELD.
Calgary Univ. (Alberta). Dept. of Botany.
Ronald W. Davies, and T. B. Reynoldson.
J Anim Ecol. 40 (1): 191-214. 1971.
Identifiers: Competition, Dwelling, Field, Food, Incidence, Intensity, Lake, Predation, Triclad.

Predation on triclad populations living in the stony littoral zone was insufficient to reduce them below the level at which intraspecific competition for food regulated the population. In small weedy habitats predation was capable of eliminating triclad populations or reducing them to a level at which competition for food was unlikely. In extensive weedy habitats competition for food was still found to occur.—Copyright 1971, Biological Abstracts, Inc.
W72-01948

DETERMINING THE DEMAND AND ECONOMIC VALUE FOR THE WATER-BASED OUTDOOR RECREATION RESOURCES AT LAKE MACBRIDE STATE PARK IN THE SUMMER OF 1970.
Iowa Univ., Iowa City. Water Resources Research Inst.
For primary bibliographic entry see Field 06D.
W72-01980

ANALYTICAL SOLUTION FOR THE WIND-DRIVEN CIRCULATION IN A LAKE CONTAINING AN ISLAND.
National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center.
M. E. Goldstein, and R. T. Gedney.
Available from National Technical Information Service, Springfield, Va. as NASA-TN-D-6541, \$3.00 paper copy, \$0.95 in microfiche. National Aeronautics and Space Administration, Technical Note, NASA-TN-D-6541, November 1971. 77 p. 20 fig. 4 ref.

Identifiers: *Water circulation, *Winds, *Lakes, *Islands, *Analytical techniques, Currents (Water), Turbulent flow, Mathematical studies, Equations, Lake morphology, Lake morphometry, Input-output analysis.

The effect of an island on the wind driven currents in a shallow lake or sea was developed through an analysis that can be applied to a large class of lake and island geometries and bottom topographies. Detailed numerical results were obtained for a circular island located eccentrically or concentrically in a circular lake with a logarithmic bottom topography. An island can produce volume flow (vertically integrated velocities) gyres that are completely different from those produced by a normal basin without an island. These gyres in the neighborhood of the island will produce different velocity patterns, which include the acceleration of flow near the island shore. (Woodard-USGS)
W72-02022

PERMAFROST-HYDROGEOLOGIC REGIMEN IN TWO ICE-FREE VALLEYS, ANTARCTICA, FROM ELECTRICAL DEPTH SOUNDING.
Northern Illinois Univ., DeKalb. Dept. of Geology.
For primary bibliographic entry see Field 02C.
W72-02030

OBSERVATIONS OF THE MUD-WATER INTERFACE.
Georgia Univ., Athens. Dept. of Zoology.
J. E. Schindler, and K. R. Honick.

Research Report, (1971). 10 p. 2 fig. 16 ref. OWRR A-029-GA (2).

Identifiers: *Mud-water interfaces, *Lakes, *Oxidation-reduction potential, *Sulfates, *Chemical reactions, Bacteria, Eutrophication, Water chemistry, Limnology, Sampling, Analytical techniques, Georgia.

The role of sulfate-reducing bacteria in the creation and maintenance of reducing conditions at the mud-water interface is discussed in relation to lake stagnation. Transport of nutrients to the euphotic zone of lakes during periods of mixing requires that nutrients remain in solution in the presence of oxygen. Ionic ferrous iron rapidly oxidizes and precipitates in the presence of oxygen. However, iron released in association with organic complexes oxidizes at a slower rate, with the rate dependent upon the type of organic material. Many of the phenomena observed at the mud-water interfaces of lakes may be explained by biological mediation, especially anaerobic conditions created by seasonal imbalance between populations of these organisms may be of great importance in regulating the nutrient balance in lakes, particularly when organic-metallic complexing is considered. (See also W72-02053 and W72-02054) (Woodard-USGS)
W72-02052

ORGANIC-INORGANIC ASSOCIATIONS: THEIR FORMATION AND INVOLVEMENT IN NUTRIENT MOBILIZATION FROM THE SEDIMENTS OF LAKES.
Georgia Univ., Athens. Dept. of Zoology.
J. E. Schindler, K. R. Honick, and J. J. Alberts.
Research Report, (1971). 18 p. 8 fig. 10 ref. OWRR A-029-GA (3).

Identifiers: *Sediments, *Lakes, *Chemical reactions, *Organic matter, *Inorganic compounds, Mud-water interfaces, Nutrients, Iron, Water chemistry, Magnesium, Manganese, Stagnant water, Limnology, Anaerobic conditions, Georgia.

Molecular weight fractionation procedures were used to examine organic-inorganic complex formation involved in nutrient mobilization from the sediments of lakes. Fe, Mg, and Mn were found associated with fractions greater than 500 molecular weight. No evidence was found for the occurrence of the ionic states of these metals in the anaerobic environment of stagnant lakes. (See also W72-02052 and W72-02054). (Woodard-USGS)
W72-02053

OXIDATION-REDUCTION DETERMINATIONS AT THE MUD-WATER INTERFACE.
Georgia Univ., Athens. Dept. of Zoology.
J. E. Schindler, and K. R. Honick.
Research Report, (1971). 11 p. 5 fig. 19 ref. OWRR A-029-GA (5).

Identifiers: *Mud-water interfaces, *Oxidation-reduction potential, *Ponds, *Sediments, *Georgia, *Analytical techniques, Sampling, Nutrients, Water chemistry, Limnology chemical reactions, Bottom sediments.

Intact samples of the mud-water interface and the overlying waters were obtained by means of a free-fall corer with a transparent plastic insert for oxidation-reduction determinations. The cores were collected from a thermally-stratified fish pond near the University of Georgia. Redox profiles across the mud-water interface and through the overlying hypolimnetic waters were made for the summer and autumn months. Freshly collected cores were oxidized by bubbling air through a cannula; redox potential of the water was monitored during the oxidation process. Cores were then sealed and placed in the dark. Self-reduction over time occurred. This system was found ideal for the study of the mechanisms of reduction and nutrient mobilization at the mud-water interface. (See also W72-02052 and W72-02053) (Woodard-USGS)
W72-02054

MULTIRESERVOIR ANALYSIS TECHNIQUES IN WATER QUANTITY STUDIES.
Saskatchewan-Nelson Basin Board, Regina.
For primary bibliographic entry see Field 04A.
W72-02057

COMPLEX-USE MANAGEMENT OF THE KARASUK-BURLA LAKES (KOMPLEKSNOYE KHOZYAYSTVENNOYE ISPOL'ZOVANIYE KARASUKSKO-BURLINSKIKH OZER).
Novosibirsk Pedagogical Inst. (USSR).
For primary bibliographic entry see Field 04A.
W72-02069

SALINITY OF SURFACE WATER IN THE LOWER COLORADO RIVER - SALTON SEA AREA.
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02K.
W72-02074

A PRELIMINARY EVALUATION OF HYDROLOGIC CONDITIONS OF THE LAKE-LAND RIDGE AREA OF POLK COUNTY, FLORIDA.
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04B.
W72-02086

A STATISTICAL THEORY OF WATER LEVEL FLUCTUATIONS IN UNDRAINED BODIES OF WATER (O STATISTICHESKOY TEORII KOLEBANIY UROVNEY VODY V BESS-TOCHNYKH VODOYEMAKH).
Moscow State Univ. (USSR).
G. P. Kalinin.

Meteorologiya i Gidrologiya, No 6, p 76-82, June 1971. 1 fig, 1 tab, 7 ref.

Identifiers: *Statistical methods, *Theoretical analysis, *Lakes, *Bodies of water, *Water level fluctuations, Water levels, Water resources, Water balance, Heat balance, Streamflow, Humidity, Moisture content, Air masses.

Identifiers: *USSR, Global hydrology, Atmospheric moisture, Correlation coefficient.

The regularities of water level fluctuations for lakes of various sizes are studied in conjunction with the heat and water resources of the earth's continents. A statistical analysis of a water balance equation for an undrained lake permits a theoretical determination of the coefficient of correlation between water levels observed at successive intervals of time. The statistical theory provides an approach to the solution of the behavior of a succession of water levels in relation to their average value, as well as a means of analyzing the development of nonrandom fluctuations of water level. At present the role of streamflow in the formation of atmospheric moisture is important but not always taken into account. The presence of a global system of observations of atmospheric moisture and of the transfer of air masses will create opportunities to evaluate the role of streamflow in the changes of atmospheric moisture content. (Josephson-USGS)
W72-02097

PRESENT-DAY AND LONG-TERM WATER AND SALT BALANCE OF SOUTHERN SEAS OF THE USSR (AZOV, CASPIAN AND ARAL) AND POSSIBLE CHANGES IN THEIR HYDROLOGIC AND HYDROCHEMICAL REGIMES (SOVREMENNYY I PERSPEKTYVNY VODNYY I SOLEMOV BALANS I VOZMOZHNYYE IZMENENIYA GIDROLOGICHESKOGO I GIDROKhimICHESKOGO REZHIMOV YUZHNYKH MOREY SSSR (AZOVSKOGO, KASPIYSKOGO I ARAL'SKOGO).
State Oceanographic Inst., Moscow (USSR).
A. I. Simonov.
Meteorologiya i Gidrologiya, No 6, p 92-101, June 1971. 3 fig, 1 tab, 4 ref.

Field 02—WATER CYCLE

Group 2H—Lakes

Descriptors: *Lakes, *Bodies of water, *Water balance, *Salt balance, *Water resources development, Water management (Applied), Administration, Fish management, Rainfall-runoff relationships, Streamflow, Water level fluctuations, Consumptive use, Withdrawal, Water chemistry, Salinity, Salts.
Identifiers: *USSR, Sea of Azov, Caspian Sea, Aral Sea.

The problem of conserving and developing the natural resources of the Caspian, Azov, and Aral Seas is part of a broad program in the complex use and conservation of the water resources of the USSR. The economic potential of these bodies of water depends to a great extent on their water regime, which, in turn, is determined by the inflow of river waters into the sea and by climatic conditions. Unfavorable natural processes and the completion of a number of water management measures, including dam and reservoir construction, are reflected in the economy of the seas and in their reduced biological productivity and fish catch. Further development of the national economy in these basins will result in increased water consumption and in the regulation of streamflow. According to data of the All-Union Planning, Surveying, and Scientific Research Institute (Gidroproyekt), consumptive use in the Azov Sea basin will double by the year 2000, while that in the Caspian and Aral Sea basins will increase 2.4 and 1.5 fold, respectively. Specific water management measures are outlined for each body of water to stimulate the development of various branches of the national economy in the basin and to conserve and increase the natural resources of the lake under conditions of regulated streamflow. (Josephson-USGS)
W72-02099

MICROFUNGI IN THE WATER, MUD, AND LITTER OF A CATTAIL MARSH,
Wisconsin State Univ., Oskosh. Dept. of Biology;
and Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05C.
W72-02112

CHARACTERIZATION OF INORGANIC PHOSPHATE IN NONCALCAREOUS LAKE SEDIMENTS,
Wisconsin Univ., Madison. Water Chemistry Lab.
J. D. H. Williams, J. K. Syers, D. E. Armstrong, and R. F. Harris.
Soil Science Society of America Proceedings, Vol 35, No. 4, p 556-561, 1971. 1 fig, 4 tab, 22 ref.
OWR-B-022-WIS (5).

Descriptors: *Inorganic compounds, *Phosphates, *Lakes, *Sediments, Calcium, Iron, Wisconsin, Aluminum, Detritus, Organic matter, Measurement, Laboratory tests.
Identifiers: *Noncalcareous sediments, Apatite, Fractionation, Wisconsin lakes.

The forms of inorganic phosphorus in a range of noncalcareous surficial Wisconsin lake sediments, determined by the fractionation procedure of Williams, Syers, and Walker (1967), are reported. The 15 noncalcareous sediments considered here are part of a group of 16 noncalcareous and nine calcareous surficial sediments taken by Ekman dredge from several lakes. Inorganic P added with 0.5 molar ammonium fluoride to noncalcareous sediments was recovered in the ammonium fluoride and succeeding 0.1 normal sodium hydroxide extractions. Values of ammonium fluoride phosphorus corrected on the basis of the recovery of phosphorus added with the ammonium fluoride reagent, underestimated the total amount of inorganic P capable of interacting with ammonium fluoride, but by less than the corresponding uncorrected values. The very high correlations between ammonium fluoride phosphorus, 1st sodium hydroxide phosphorus, and reductant-soluble phosphorus, on one hand, and between these three fractions and oxalate- and citrate-dithionite-bicar-

bonate-extractable Fe, on the other, indicate a common origin for the inorganic phosphorus in the three fractions as part of a short range order Fe-rich complex. Apatite was low in all sediments. (Jones-Wisconsin)
W72-02113

BLUEGREEN ALGAE OF THE CRIMEAN MINERALIZED RESERVOIRS (IN UKRAINI-AN),
Akademi Nauk USSR, Lvov. Inst. of Botany.
N. S. Vodop Yan.
Ukr Bot Zh. 27 (2): 165-170. 1970, English summary.

Identifiers: Algae, Blue-Green, Crimean, Cyanothrix-Gardneri-F-Caspica, Gomphosphaeria-Aponina-F-Delicatula, Mineralized, Reservoirs, USSR.

Most of the 103 spp. found belong to the Hormogoniophyceae particularly the Oscillatoriaceae. In the class Chroococophyceae the Chroococcales is the richest in species. Two species are new for the Ukraine, *Cyanothrix gardneri* (Fremy) I. Kissel, *S. ampl f. caspica* I. Kissel and *Gomphosphaeria aponina*, Kuetz. f. *delicatula* (Vir.) Elenk. Distribution of Cyanophyta in the Crimean mineralized reservoirs depends to a great extent on the total mineral content. The floristic composition of the oversalinated reservoirs is the most unusual.—Copyright 1971, Biological Abstracts, Inc.
W72-02183

THE ECOSYSTEM OF THE ARCTIC LAKE NORDLAGUNA, JAN MAYEN ISLAND: II. PLANKTON AND BENTHOS,
Marine Biological Station, Tromsø (Norway).
Stig Skrelet, and Niels Foged.

Astarte. 3 (2): 53-61. Illus. Map. 1970.

Identifiers: Arctic, Benthos, Chironomidae, Cladocera, Diatoma-Elongatum, Ecosystem, Gastrotricha, Island, Jan-Mayen, Lake, Nematoda, Nordlaguna, Oligochaeta, Plankton, Tardigrada, Turbellaria.

In 1963 plankton samples were taken in the oligohaline lake Nordlaguna by plankton sampler and vertically hauled tow net. Information on benthos was obtained in 1963 by SCUBA diving and grab collecting, and in 1965 by a new diver operated quantitative sediment sampler. The planktonic diatom flora of Nordlaguna was rich in quantitative respects, owing to mass occurrence of *Diatoma elongatum*. No zooplankton was found. The benthic fauna comprised small species of Turbellaria, Gastrotricha, Nematoda, Oligochaeta, Cladocera, Tardigrada, and Chironomidae.—Copyright 1971, Biological Abstracts, Inc.
W72-02190

FURTHER STUDIES ON SOME SALINE LAKES OF SOUTHEAST AUSTRALIA,
Monash Univ., Clayton (Australia). Dept. of Zoology.

I. A. E. Bayly.
Aust J Mar Freshwater Res. 21 (2): 117-129. Illus. Map. 1970.

Identifiers: *Acartia-Clausi*, Australia, *Capitella-Capitata*, *Ceratonereis-Erythraeensis*, *Culicoides*, *Heterolaophonte*, Lakes, *Mesochra*, *Mesostoma*, *Onychocampus-Bengalensis*, *Robertsonia*, Saline, Southeast.

A series of closed saline lakes located between Beachport and Robe in South Australia are discussed in more detail than previously. The following taxa are reported for the 1st time: the polychaete *Capitella capitata* (Fabricius), the dipteran *Culicoides*, the turbellarian *Mesostoma*, and the copepod *Acartia clausii* Giesbrecht. New taxa that will be described by other workers wholly or partially from material collected in this region are as follows: a new species and genus of hydrozoan probably belonging to the genera *Mesochra*, *Robertsonia*, and *Heterolaophonte*. Previously

recorded taxa which have now been more closely identified are as follows: 'Nereidae' (earlier paper) — *Ceratonereis erythraeensis* Fauvel (present paper), *Onychocampus sp.* — *O. bengalensis* (Sewell), and *Halicyclops sp. nov.* — *H. ambiguus* Kiefer. The cladoceran *Daphniopsis pusilla* Serventy is recorded from a salinity of 57%. The significance of resistant stages, and the biological status of closed saline lakes located close to the sea, are discussed.—Copyright 1971, Biological Abstracts, Inc.
W72-02191

PLANKTON SWARMS IN LAKE GJOKVATN, EAST FINNMARK,
Tromsø Museum (Norway).
Anders Kiemetsen.

Astarte. 3 (2): 83-85. 1970.

Identifiers: *Bosmina-Obtusirostris*, East, Finnmark, Gjokvatn, Lake, Norway, Plankton, Swarms.

Distinct swarms of *Bosmina obtusirostris* were observed near the surface of the lake during the daytime. The swarms were irregularly spindle- or fan-shaped and from 10 to 50 cm long. Numbers may vary from 1000 to 100,000 individuals per swarm. The observations indicate that biological rather than physical factors are involved in swarm formation.—Copyright 1971, Biological Abstracts, Inc.
W72-02193

AMOUNT OF PIGMENTS AND DAILY PRODUCTION OF PHYTOPLANKTON OCCURRING IN ACIDIC LAKE TOYA (IN JAPANESE),
Hokkaido Univ. (Japan). Faculty of Fishery.
For primary bibliographic entry see Field 05C.
W72-02197

LIMNOLOGICAL STUDIES ON PARAMBIKULAM ALIYAR-PROJECT-I ALIYAR RESERVOIR (MADRAS STATE), INDIA,
Hydrological Research Station, Kilpauk (India).
A. Sreenivasan.

Schweiz Z Hydrol. 32 (2): 405-417. 1970.

Identifiers: Aliyar, Diatoms, India, Limnological Madras, *Microcystis-Aeruginosa*, Oxygen, Parambikulam, Project, Reservoir.

The limnology of a softwater impoundment has been studied. The deep reservoir did not exhibit stable thermal stratification though biochemical stratification was quite usual. O2 supersaturations were rare but mostly the surface water was over 50% saturated. O2 deficits were noticed but they were not severe. Anoxic bottom condition was noted only once. Low alkalinity, low hardness, low chloride, Ca. silicate were characteristic of this water. Nitrate was not detected, but on some days phosphates were recorded. O2 absorbed from permanganate was fairly high. Though chemical parameters indicate its oligotrophic nature, plankton composition gives the contrary impression. Blue-greens especially *Microcystis aeruginosa* occurred almost round the year. Diatoms also occurred throughout the year with 2 exceptions. Primary production values varied but were high during diatom abundance and restricted by low nutrient levels, low CO2 and lower plankton numbers. Vertical and diurnal changes in alkalinity, dissolved O2 and pH values point to a moderately eutrophic tendency.—Copyright 1971, Biological Abstracts, Inc.
W72-02198

LIMNOLOGICAL STUDIES OF LAKE NORRVIKEN, A EUTROPHICATED SWEDISH LAKE: II. PHYTOPLANKTON AND ITS PRODUCTION,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 05C.
W72-02199

WATER CYCLE—Field 02

Water in Plants—Group 21

21. Water in Plants

PREDICTING VARIATIONS IN ENERGY FLOW THROUGH A SEMI-CONTROLLED LOTIC ECOSYSTEM,
Michigan State Univ., East Lansing. Kellogg Biological Station.
K. W. Cummins.

Available from the National Technical Information Service as PB-204 645, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report, 1971. 21 p, 6 fig, 2 ref. OWRR-B-008-MICH (2), 14-13-0001-3093.

Descriptors: *Ecology, *Streamflow, *Lotic environment, *Ecosystems, *Model studies, Land clearing, Land development, Clear-cutting, Forestry, Agriculture, Urbanization, Organic matter, Leaves, Sediments, Forecasting.

A generalized model for woodland stream ecosystem structure and function was developed. Particular focus was directed toward the processing of detritus of terrestrial origin, primarily leaf litter, by the stream community. The ecology of natural and artificially prepared leaf accumulations was followed in woodland streams and in greenhouse channels. Massive alterations of the landscape have caused many streams to become autotrophic or greatly simplified heterotrophic systems. Even though the quantity and quality of organic inputs may be similar to the initial woodland heterotrophic stream, it is difficult to reestablish and intricate and efficient processing structure that characterized the original stream system. This is particularly true when treatment facilities are employed which are specifically designed to insure the input of only fine particulate and dissolved organic matter. A key to the original structure is the input of large detrital particles to serve as fungal substrates and food for the shredders (large particle detritivores). (Woodard-USGS) W72-01701

HYDROLOGIC CHARACTERIZATION OF FORESTED WATERSHEDS IN ARIZONA,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 02C.
W72-01702

ECOPHYSIOLOGICAL STUDIES ON PLANTS IN ARID AND SEMIARID REGIONS IN WESTERN AUSTRALIA. IV. COMPARISON OF THE FIELD PHYSIOLOGY OF THE HOST, ACACIA GRASBYI AND ITS HEMIPARASITE, AMYEMA NESTOR UNDER OPTIMAL AND STRESS CONDITIONS,
Western Australia Univ., Nedlands. Dept. of Botany.
E. O. Hellmuth.
Journal of Ecology, Vol. 59, No. 2, p. 351-363, July 1971. 5 fig, 3 tab, 17 ref.

Descriptors: *Physiological ecology, *Plant populations, *Photosynthesis, *Transpiration, *Moisture stress, Osmotic pressure, Plant physiology, Arid lands, Diurnal, Seasonal, Stomata, Environmental factors, Ecology, Mode of action, Air temperature, Soil moisture, On-site investigations. Identifiers: *Plant parasites, *Australia.

The ecophysiological parameters, photosynthesis, respiration, transpiration, water deficit and osmotic potential, were investigated in the stem hemiparasite *Amyema nestor* and its host *Acacia grasbyi* in an arid region under optimal conditions in winter and stress conditions in late summer. Under mild air environment and good soil water conditions in winter, the diurnal patterns of physiological processes were of the 1-peak type for the host as well as the hemiparasite, but the curves obtained for the host were markedly flatter. An exception, rates of transpiration, were slightly higher in the host. Under stress conditions, the diurnal patterns of net photosynthesis, transpiration and water deficits showed multiple-peak curves for

both species, and while these activities in the hemiparasite changed little in comparison to optimal conditions, they were considerably reduced in the host. Phyllodes of uninfected *Acacias* under stress conditions showed 1-peak type patterns. By this indirect approach, it was concluded that the field physiology of the host as a whole is affected by the hemiparasite under stress conditions. Apparently the hemiparasite induces additional water stress in the host which results in complete or partial stomatal closure and consequent reduction in net photosynthesis. (Casey-Arizona) W72-01740

DROUGHT INFLUENCE ON PHYSIOLOGICAL PROCESSES AND SUBSEQUENT GROWTH,
California Univ., Davis. Dept. of Agronomy and Range Science.
For primary bibliographic entry see Field 03F.
W72-01758

PATTERN IN DESERT PERENNIALS,
Australian National Univ., Canberra. Research School of Biological Sciences.
D. J. Anderson.
Journal of Ecology, Vol 59, No 2, p 555-560, July 1961. 2 tab, 21 ref.

Descriptors: *Ecological distribution, *Plant populations, *Biological communities, *Shrubs, *Arid lands, Competition, Statistical models, Rainfall, Moisture stress.

Desert perennial vegetation, and particularly shrubs, have the appearance of regular spacing. Recent studies have shown a great diversity of pattern in desert species, including regular, random and contagious. This diversity is particularly surprising if pattern in desert perennial populations is primarily determined by the interactions between low rainfall regime and competition between adjacent plants for the limiting water resource. The 3 recent papers offering evidence for desert shrub regularity are critically reviewed. The results of 2 of the papers are discarded for methodological reasons and the basic assumptions of the third are shown to be fallacious. Much evidence now exists to suggest that cyclical patterns, involving changes in both scale and intensity in relation to age-phases, are common features of perennial plant populations. The younger plants in a population tend to be contagiously distributed. This contagion gradually disappears with increasing age of the population, due to elimination of individuals from the high density phases of the originally patterned mosaic, producing eventually an essentially random distribution among the oldest individuals of the population. There is therefore no reason to assume regularity is the most likely form of distribution among shrubs in an arid region, much less to argue that if it does occur it is due competition for water. (Casey-Arizona) W72-01760

PSYCHROMETRIC DETERMINATION OF WATER POTENTIAL OF DESERT PLANTS,
Battelle Northwest, Richland, Wash. Environmental and Life Sciences Div.; and Washington State Univ., Pullman. Dept. of Agronomy.
J. Hsieh, G. S. Campbell, and W. H. Gardner.
Northwest Science, Vol 45, No 3, p 209-212, August 1971. 1 fig, 2 tab, 7 ref. AEC Contract AT (45-1)-1830.

Descriptors: *Xerophytes, *Moisture stress, *Water balance, *Soil-water-plant relationships, *Instrumentation, Temperature, Humidity, Leaves, Semiarid climates, Shrubs, Hydrophytes, Climatic data, Rainfall, Environmental effects. Identifiers: *Water potential.

Thermocouple psychrometry is increasingly used to measure leaf water potentials. Unfortunately, technical problems have precluded such measurements on xerophyte leaves because the instrument is limited to ranges between 0 and -50 bars. Using a

Spanner thermocouple psychrometer, this range was extended to about -100 bars by use of special thermocouple welds and by increasing the time of Peltier cooling. Water potentials were measured in the leaves of 4 desert shrubs and 1 hydrophyte native to the semidesert of eastern Washington. Measurements were made in the morning and the afternoon of the day in November and a day in September. Critical climatic data were also recorded on each occasion. As the season advanced, leaf water potentials increased probably due to late fall rains and decreasing atmospheric stress brought about by lower temperatures and high relative humidities. The relative importance of atmospheric conditions was indicated by the data on the hydrophyte. (Casey-Arizona) W72-01761

LIST OF FRESHWATER CRUSTACEANS OF CUBA AND THEIR ZOOGEOGRAPHICAL RELATIONSHIPS,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
M. Straskraba.
Acad Cien Cuba Ser Biol. 8. 1-37. 1969.
Identifiers: Crustaceans, Cuba, Fresh, Geographical, List, Relationships.

An annotated list, giving general distribution, is given for 55 spp., comprising 2 spp. of Conchostraca, 7 of Cladocera, 4 of Copepoda, 6 of Ostracoda, 1 of Mysidacea, 4 of Isopoda, 3 of Amphipoda, 20 of Decapoda, and 8 of Brachyura. Altogether, 28 spp. are endemic in Cuba, 5 endemic in the Greater Antilles, 5 occur in Mexico and part of Central America as well as in the Greater Antilles, 4 occur also in the northern part of South America and the southern part of North America, and 3 are cosmopolitan and widely distributed, while 2 are not classified because their origin is uncertain. The bibliography lists 57 publications on the crustacean fauna of Cuba, and 34 which deal with the zoogeographical relationships of Cuban crustaceans.—Copyright 1971, Biological Abstracts, Inc. W72-01887

EFFECT OF SOME SOIL PROPERTIES ON ROOT AND TOP GROWTH AND MINERAL CONTENT OF 'WASHINGTON' NAVAL ORANGE AND 'BALADY' MANDARIN,
F. A. Minessy, M. A. Barakat, and E. M. El-Azab.
Plant Soil. 34 (1): 1-15. Illus. 1971.
Identifiers: Balady, Growth, Leaf, Mandarin-D, Mineral, Navel, Number, Orange-D, Root, Salinity, Shoot, Soil, Table, Top, Vigor, Washington, Yield.

Soil and plant investigations were carried on a grove of 'Washington' navel orange and 'Balady' mandarin in the United Arab Republic to find out the cause of the large differences in the tree vigor. During 1965 and 1966 the groundwater level was measured several times, groundwater and soil samples were analyzed, new shoots and leaves in 3 flushes/year were determined. Root intensity at distance and depth were also determined. Roots and leaves were analyzed for several mineral contents. Results obtained refer to the depth of water table as the dominant factor responsible for growth differences, whereas salinity as secondary effect mostly was not involved. The number of shoots (for both cultivars) was the most affected. Total leaf area (reflecting all other effects) was reduced tremendously by water table change from 171 to 53 cm for orange and from 158 to 89 cm for mandarin. Travelling distance of feeder roots, horizontally or vertically was reduced remarkably and its intensity shifted upward in front of a rising water table. Mineral contents did not change with water table. Yield of both cultivars was remarkably reduced with rising water table.—Copyright 1971, Biological Abstracts, Inc. W72-01891

Field 02—WATER CYCLE

Group 2I—Water in Plants

RELATIONS BETWEEN THE AGE OF CLONE AND THE COURSE OF MEIOSIS OF SPAHEROCARPUS (IN GERMAN).

Humboldt-Universität zur Berlin (East Germany). Biology Section.

Biol Zentralbl. 90 (1): 43-48. Illus. 1971. English summary.

Identifiers: Aberrant, Age, Clones, Evolution, Germination, Meiosis, Relations, Sphaerocarpus, Spore, Stress.

The meiosis of Sphaerocarpus shows a higher rate of disturbances in older clones than in younger ones. For an analysis of the responsible factors, treatments with water stress were carried out, the effect being that water stress plants showed a much higher degree of disturbances. It was observed that aberrant spores are able to germinate. The possible consequence in evolution is discussed.—Copyright 1971, Biological Abstracts, Inc.

W72-01894

TIME AND EFFECT OF FOREST FERTILIZATION,

P. J. Viro.

Metsantutkimuslaitoksen Julk. 70 (5): 3-16. 1970.

Identifiers: Fertilization, Forest, Pine-G, Rain, Seasonal, Spruce-G, Time.

In the summers of 1964 and 1965 the distribution of the rains was so uneven that an occasional shower of rain probably had a great effect on the results. The spruce plots differed more than the pine plots in the mechanical composition of their soil, but as the plots in both the spruce series were established in the same locality and during the same year, their fertilization reaction was similar. Early summer is the best time for fertilizing pine, and late and early summer for spruce. Winter fertilization is fairly advantageous; when the soil is frozen, little of the fertilizer evidently gets leached away unless heavy rains fall between the thaw and the commencement of growth. Differences due to weather and soil have to be considered in fertilization experiments.—Copyright 1971, Biological Abstracts, Inc.

W72-01907

EFFECTS OF LIGHT INTENSITY AND OSMOTIC STRESS ON THE WATER RELATIONS OF *POPULUS TREMULOIDES*,

International Paper Co., Ticonderoga, N.Y.

James O. Eubanks.

Forest Sci. 17 (1): 79-82. Illus. 1971.

Identifiers: Cell, Dry, Intensity, Light, Moisture, Osmotic, *Populus-Tremuloides-D*, Pressure, Reduction, Relations, Stress, Turgor, Weight.

Growth and osmotic relationships were examined in quaking aspen plants subjected to osmotic moisture potentials from -0.5 to -15.5 bars, and light intensities from 900 to 3,600 foot-candles. Reductions in plant dry weight, as moisture stress increased, were related to reduce cell turgor pressure. Variations in light intensity apparently had little effect on the water potential of the leaves. As light intensity was decreased, however, cell turgor pressure also decreased. Both reduced turgor pressure and reduced photosynthesis may be directly related to inability of the plants to grow under conditions of low light intensities.—Copyright 1971, Biological Abstracts, Inc.

W72-01909

WILDLIFE CRISIS,

Philip Duke of Edinburgh, and James Fisher.

Cowles, New York, N.Y., 1970. 256 p. Illus. Pr. \$14.95.

Identifiers: Birds, Book, Conservation, Crisis, Extinction, Human, Mammals, Movement, Threat, Wildlife.

This volume contains an illustrative and informative commentary on the world's wildlife and its conservation. Wildlife conservation is considered

with note of the effects of the scientific and technological explosion, the growth of urban populations, the rapid depletion of the natural supply of water, the vanishing of species and the critical nature of the world's food supply. The concern for preserving natural beauty is stressed with note of the 'big business' of wild animal photography. A photographic assay of bird and wildlife observation is included showing wildlife from areas ranging from Antarctica to the Galapagos Islands and Lake Rudolf in Kenya. Also included is a comprehensive history of world's conservation movement. Prepared with the assistance of the World Wildlife Fund and the International Union for the Conservation of Nature and Natural Resources, it considers each continent's participation in this concern. A section of the text devoted to an account of the most notable mammalian and bird species that have been affected by man's indifference or concern lists 4 types of species: globally extinct, endangered, critically endangered and saved from extinction by man's intervention. Over 32 color plates and 8 maps illustrate the text; bibliography and index are also included.—Copyright 1971, Biological Abstracts, Inc.

W72-01911

NATURAL PRODUCTIVITY OF WILDFOWL ON THE NAMESTSKÉ RUBNIKY PONDS (CZECHOSLOVAKIA),

Ceskoslovenska Akademie Ved, Brno. Ustav pro Vyzkum Obratovcu. Jiri Havlin.

Zool Listy. 19 (4): 343-364. Illus. 1970.

Identifiers: Czechoslovakia, Ducks, Egg, Grebe, Gull, Namestské, Natural, Ponds, Production, Productivity, Rails, Rybníky, Sedge-M, Warblers, Weather, Wildfowl.

In the period of 1966 to 1969, the breeding success of all birds nesting on the largest pond (of about 30 ha in average) of the above-mentioned pond system was recorded, except for the black-headed bull gull and the black-necked grebe. The number of nests of 18 breeding spp. varied between 215 and 138. In 1966 to 1968, the number of nests culminated following a decrease lasting several years since 1961. Low numbers persisted only in the coot, little and black-necked grebe. In 1969, a general decrease recurred. The number of eggs laid varied approximately between 1600 (in 1967) and 800 (in 1969), the number of young having left successfully the nest varied between 990 and 450. In this production, ducks take part by a half; rails, by a quarter; and weed warblers, and little grebe and others represent the rest. The mean production in ducks was 5 to 6 young from one commenced clutch, whereas in 1969 it was only 2.4 to 2.8 young. In the same years, the breeding success was also ascertained in a part of wildfowl nests on the other ponds of the system; in 1968 and 1969, in the absolute majority of these nests; in 1969, additionally, in a part of nests on the relatively poor ponds in the wider environs. The disease in the number of breeding pairs on the largest pond in 1969 was compensated partly by more frequent breeding on the other ponds. The total egg production in wildfowl species on the largest pond equals approximately to that in all the other ponds, although the total acreage of the latter is 5 times that of the former. The breeding success appears to be somewhat greater on the ponds with lower breeding density, as well as in the years with a lower number of breeding pairs. Nevertheless, the lowest breeding success was recorded under unfavorable conditions of 1969. The number of breeding pairs, as well as the total production of eggs and young, were most affected by both the course of weather and the way and intensity of fish management on the ponds. Suitable nesting conditions enabled considerably high nest concentration on the largest pond. The impairing of these conditions, mainly the disappearance of sedge tufts, led to abrupt disease in breeding and, at the same time, to dispersion of breeding pairs towards other ponds. The influence of unfavorable weather and other factors markedly reflected the production of eggs and young than the number of breeding cases.

The results have proved overproduction, and have not corroborated the hypothesis that the production of young per year might be a factor controlling the breeding rate in the subsequent year.—Copyright 1971, Biological Abstracts, Inc.

W72-01912

THE POPULATIONS, GROWTH AND PRODUCTION OF FISH IN FOUR SMALL STREAMS IN SOUTHERN ENGLAND,

Freshwater Biological Association, Wareham (England). River Lab.

R. H. K. Mann.

J Anim Ecol. 40 (1): 155-190. Illus. 1971.

Identifiers: *Cottus-Gobio*, England, Fish, *Gasterosteus-Aculeatus*, Growth, *Nemacheilus-Barbatus*, *Phoxinus-Phoxinus*, Populations, Production, *Salmo-Salar*, *Salmo-Trutta*, Southern, Streams.

Survival, growth and annual production of 6 spp. of fish were measured in 1 soft water and 5 hard water stream sites in southern England, the species studied being trout (*Salmo trutta*), salmon parr (*S. salar*), bullhead (*Cottus gobio*), stone loach (*Nemacheilus barbatus*), three spined stickleback (*Gasterosteus aculeatus*) and minnow (*Phoxinus phoxinus*). There were only minor differences in the growth rates of fish at the 5 hard water sites, but these rates were higher than those for the same fish species in the softer Docken's Water. At all sites growth was most rapid in the spring and early summer and though growth continued throughout the year there was a considerable decrease in the rate during the winter months. Annual bullhead production ranged from 6.2 to 43.1 g/m sq (fresh weight) in the hard-water streams and this represented from 43 to 83% of total fish production. Bullhead production was greatest during the 1st few months of life and was correlated directly with the density of the 0 group population. Trout production ranged from 2.6 to 12.9 g/m sq/annum (fresh weight) at the hard water sites and contributed from 7 to 37% to the total fish production at each site. There was a more even distribution of production among the age groups than in the bullhead, and trout production at each site was affected by the proportion of each age group present. In the soft water stream trout contributed 87% (12.1 g/m sq) of annual fish production, with most of the remainder coming from the minnow population. Bullheads did not occur in this stream.—Copyright 1971, Biological Abstracts, Inc.

W72-01913

INFLUENCE OF ACTIVITY AND SALINITY ON THE WEIGHT-DEPENDENT OXYGEN CONSUMPTION OF THE RAINBOW TROUT *SMO-GAIRDNERI*,

Sir Theagaraya Coll., Madras (India). Dept. of Zoology.

G. Madan, Mohan Rao.

Mar Biol (Berlin). 8 (3): 205-212. Illus. 1971.

Identifiers: Consumption, Dependent, Oxygen, Rainbow, Salinity, *Salmo-GaIRDNERI*, Temperature, Trout, Weight.

Standard and active rates of O₂ consumption of *S. gaIRDNERI* acclimated and tested at 5 and 15°C in various salinities (fresh water to 30%) were determined. The fish used in experiments ranged in weight from 23 to 196 g. The relation between body weight and metabolism is discussed. Lowest rates of O₂ consumption were obtained in 7.5% S at both temperatures and at all levels of activity; maximum rates were obtained in 30% S (with the exception of smaller fish at 15°C). Reduction in osmotic load/cost of osmoregulation is suggested as the probable cause for the lowest rate of O₂ consumption in 7.5% S, a salinity isosmotic with the plasma of the fish. Increase in temperature results in increase of metabolic rate. However, this has no effect on the slope of the weight-metabolism regression line. In 30% S at 15°C, the response to higher levels of activity seems to be size-dependent. The slope of the regression line (weight versus O₂ consumption) increases with increasing activity at

WATER CYCLE—Field 02

Water in Plants—Group 2

15C; this is more pronounced in 30% S. However, at 5C, no significant statistical difference was observed between the slopes. The scope for activity was calculated. It was found to be lowest in 7.5% S, and the scopes in fresh water and 15% S were not different. The scope in 30% S was high at 5C but, at 15C, a reduced scope was found for smaller fish; this is a reflection of the earlier observation that small fish were unable to survive in a high salinity/high temperature combination.—Copyright 1971, Biological Abstracts, Inc.

W72-01914

THE EFFECTS OF STRATIFICATION ON PHYTO-PLANKTONIC DIATOMS IN A SMALL BODY OF WATER, Bristol Univ. (England). Dept. of Botany.

Christine M. Happay.

J Ecol. 58 (3): 635-651. Illus. 1970.

Identifiers: *Asterionella*-Formosa, Body, Circulation, Depletion, Diatoms, Growth, Phyto, Planktonic, Silica, *Stephanodiscus*-Rotula, Stratification.

The planktonic diatoms *Asterionella formosa* and *Stephanodiscus rotula* showed 4 growth peaks, the former diatom in spring 1967, and spring 1968, and the latter in summer 1967 and autumn 1967. Growth cycles on all 4 occasions varied, and were related to the water circulation. Silica depletion resulting from diatom uptake paralleled water circulation, occurring throughout the pool in autumn 1967 and spring 1968, and was confined to the top 2.5 m in spring 1967 as the pool stratified during the growth period, and to the epilimnion during summer 1967. Rates of population increase varied depending on the time of year. Low specific rates of population increase were exhibited by the early spring growth of *Asterionella* in 1968 and maximum rates were recorded for the summer crop of *Stephanodiscus*. Comparable amounts of silica were used by populations of both diatoms. The crops of *Asterionella* with a smaller silica demand per cell were denser than those of *Stephanodiscus* and the quantity of silica uptake is related most closely to the surface area and hence wall dimensions of the 2 diatoms. These diatom populations show unusual characteristics of phytoplankton. *Asterionella*, when growing during the development of thermal stratification in May 1967, was able to maintain a 'static' population under conditions of silica depletion; the size of population was determined by the diffusion of silica from the silica-rich hypolimnion. *Stephanodiscus* produced a large crop during stable thermal stratification in July, and this growth was probably governed by very rapid cell division sufficient to account for the increases in cell numbers and loss by sedimentation to the hypolimnion. Thus stratification conditions in a shallow water mass are of great importance in controlling diatom populations, normally associated with turbulent water, not only in their effect on water circulation but also in the provision of nutrients.—Copyright 1971, Biological Abstracts, Inc.

W72-01919

PHOTOSYNTHESIS IN FRUTICOSE LICHENS CLADONIA ALPESTRIS (L.) RABH. AND C. RANGIFERINA (L.) WEB. IN THE TAIMYR PENINSULA, (IN RUSSIAN),

E. A. Barashkova.

Bot Zh. 55 (2): 284-292. Illus. 1970.

Identifiers: *Cladonia*-Alpestris, *Cladonia*-Rangiferina, Fruticose, Lichens, Light, Moisture, Peninsula, Photosynthesis, Taimyr, Temperature, USSR.

Photosynthesis of *Cladonia alpestris* (L.) Rabh. and *C. rangiferina* (L.) Web. was studied under the arctic conditions of the Taimyr National District on the watershed plateau in the dwarf birch-lichen tundra. Data on the intensity of photosynthesis obtained monthly by use of radioactive C in July (polar day), Aug. (white night) and Sept. (twilight night) showed that in the morning and evening hours it was more intense than during the day. Both species photosynthesized during night hours of the

polar day period. In *C. alpestris* the intensity reached its highest daily level in July at 3:00 A.M. The intensity depends on air temperature and moisture. With relatively low air temperature and lichen moisture content CO₂ uptake speeds up. Drying of the lichens is related with increases in light. The reason for high CO₂ uptake in the dark is still not clear. Possibly at high concentrations of CO₂ the reversible process of CO₂ exchange in plants is increased. It is undoubtedly connected with the symbiotic nature of the plant. To determine seasonal changes in photosynthesis the intensity was studied in *C. rangiferina* in Norilsk during May (polar day), March (day and night) and Aug. (twilight nights) for 6 concentrations of CO₂, 0.05-2%. Differences in intensity of assimilation and the proportion of absorption in the dark and light were noted.—Copyright 1971, Biological Abstracts, Inc.

W72-01921

AUTECOLOGY OF COMMON EGYPTIAN FAGONIA SPECIES, Baghdad Univ. (Iraq). Coll. of Sciences.

Kamal Batanovny, and Mohiey Batanovny.

Phyton (Horn, Austria). 14 (1/2): 79-92. Illus. Map. 1970.

Identifiers: Aut, Carbonates, Ecology, Egyptian, *Fagonia*-Arabica-D, *Fagonia*-Bruguieri-D, *Fagonia*-Cretica-D, *Fagonia*-D, *Fagonia*-Glutinosa-D, *Fagonia*-Mollis-D, *Fagonia*-Parviflora-D, Salts, Soil, Species.

The Egyptian Zygophyllaceous species, though small in number, are important constituents of the desert vegetation. One of the important genera is *Fagonia*. This genus comprises about 18 Egyptian species. The distribution of these species is interesting. The autecology of 6 common species is studied. Although more than one species may be present in the same locality, each of the species has its ecological limits. *F. parviflora* is particularly able to withstand very dry conditions. The carbonate content and the total soluble salts vary widely in the habitats. The chemical nature of the soil parent material seems to effect the distribution of the studied species. Couples of ecologically related species could be distinguished. These are: *F. mollis* and *F. glutinosa*, *F. glutinosa* and *F. arabica*, *F. arabica* and *F. bruguieri* and *F. bruguieri* and *F. parviflora*. *F. cretica* was also studied.—Copyright 1971, Biological Abstracts, Inc.

W72-01922

CONTRIBUTION TO THE AUTECOLOGY OF URGINEA MARITIMA IN EGYPT, Baghdad Univ. (Iraq). Coll. of Sciences.

Kamal Hassan Batanouny, and Taha Khalifa.

Phyton (Horn, Austria). 14 (1/2): 41-53. Illus. 1970.

Identifiers: Associates, Aut, Carbonates, *Echiochilon*-Fruticosum-D, Ecology, Egypt, *Gymnocarpus*-Decandrum-D, Harvest, Medicinal, Morphology, *Plantago*-Albicans-D, Post, Re, Salts, Soil, *Urginea*-Maritima-M.

Urginea maritima is a medicinal plant growing in the Mediterranean coastal region in Egypt. It includes 2 types—differing in the color of the tunic, leaf shape, scape length and fruit size. Phenological aspects are dependent on the climatic conditions, particularly rainfall. They are summarized as follows: leafy stage from Dec.-Jan. to April; dormant stage from May to Aug.; flowering stage from Aug.-Sept. to Oct.; fruiting stage from Nov. to Dec. *U. maritima* is restricted to the coastal region. Soils supporting both types of squills differ in regard to their physical and chemical properties. Soils supporting white squills are more shallow, more compact, with higher carbonate and soluble salt content. The soils inhabited by red squills are of sandstone origin while those supporting white squills are of limestone origin. Communities dominated by different types of squills occupy patches of different areas ranging from a few square meters to 2 km sq. The total plant cover during spring is higher in communities dominated by red squills than in those dominated by white squills. Species with high fidelity

to the habitat of the community dominated by red squill are characteristic of the *Plantago* *albicans*-*Echiochilon* *fruticosum* association. Those with high fidelity to the habitat of the community dominated by white squill are characteristic of the *Gymnocarpus* *decandrum* association. The soils supporting the white and red squill communities are comparable to those supporting the *Gymnocarpus* and *Plantago* associations. The average weight of white squill bulbs produced from 100 m sq is 70 kg for an average number of 430 bulbs. In case of red squills the average weight is 123 kg for 250 bulbs. Reestablishment of the white squill community needs more than 3 yr. The weight of newly produced bulbs is about 20% of that produced from a similar area under natural conditions.—Copyright 1971, Biological Abstracts, Inc.

W72-01923

VEGETATION OF THE OLOKEMEJI FOREST RESERVE, NIGERIA: VII. THE PLANTS ON THE SAVANNA SITE WITH SPECIAL REFERENCE TO THEIR SEASONAL GROWTH, Sheffield Univ. (England). Dept. of Botany.

Brian Hopkins.

J Ecol. 58 (3): 795-825. Illus. 1970.

Identifiers: Cambial, Extension, Fire, Forest, Growth, Moisture, Nigeria, Olokemeji, Photoperiod, Plants, Reserve, Savanna, Seasonal, Shoot, Site, Vegetation.

This concluding paper of the series presents the results of the seasonal changes in the growth of 17 common perennial species of differing life-form on the savanna site. Extension growth commences with a flush in late Feb. followed by a gradual decrease until about July; radial growth continues to Nov. Most leaf-fall occurs in Dec. and Jan. Cambial activity mainly occurs from Feb.-Oct. There is a large intraspecific variation, but each species shows its own particular seasonal pattern of growth. No species is 'typical'; the various types could not be classified. The general relationship between growth and rainfall is not causal, although moisture often exerts a limiting effect. The main cause of extension growth initiation is fire. The factors controlling the cessation of growth may not be the same for all species, but photoperiod is probably of prime importance. In general, the phanerophytes grew very slowly, whereas plants of other groups grew quite quickly. The tree girth increases were extremely low, probably because the records were made in particularly dry years. Leaf relative turgidity of 3 spp. was slightly less at 14.00 hours than at 08.30 hours and showed a seasonal variation related to both air and soil moisture and leaf age. The mean annual viable seed fall was about 900 seeds/m sq; almost all were grasses and virtually all fell in Nov. and Dec.—Copyright 1971, Biological Abstracts, Inc.

W72-01924

VEGETATION OF THE OLOKEMEJI FOREST RESERVE, NIGERIA: VI. THE PLANTS ON THE FOREST SITE WITH SPECIAL REFERENCE TO THEIR SEASONAL GROWTH, Sheffield Univ. (England). Dept. of Botany.

Brian Hopkins.

J Ecol. 58 (3): 765-793. Illus. 1970.

Identifiers: Forest, Forms, Growth, Life, Moisture, Nigeria, Olokemeji, Photoperiod, Plants, Reserve, Seasonal, Site, Vegetation.

An account is given of seasonal changes in the growth of 19 common species of differing life-form on the forest site. The main period of growth is from Feb.-March until about May or June, with most leaf-fall and radial shrinkage from Dec.-Feb. Most cambial activity takes place from May to Sept. Thedre is large intraspecific variation, but each species shows its own particular seasonal pattern of growth. No species is 'typical'; the various types could not be classified. The most likely factor controlling extension growth is photoperiod, but moisture often exerts a limiting effect. The factors

Field 02—WATER CYCLE

Group 21—Water in Plants

controlling growth may not be the same for all species. Growth rates were generally low, probably mainly due to lack of water. The tree girth increases were extremely low, probably because the records were made in particularly dry years. Leaf relative turgidity of 4 species fell between 10.00 and 15.15 hr and showed a seasonal variation closely related to air and soil moisture values. The mean annual viable seed fall was only 14 seeds/m sq; all the seeds fell during the dry season.—Copyright 1971, Biological Abstracts, Inc.

W72-01925

SOME DATA ON THE GROWING SITE OF HYPERICUM CANADENSE L. (IN DUTCH), Nijmegen Univ. (Netherlands). Botany Lab.

V. Westhoff.

Gorteria. 5 (7): 239-248. 1970 English summary. Identifiers: Ecosystem, Gradient, Grazing, Growing, Hypericum-Canadense-D, Native, Site, Soil, Species.

Hypericum canadense L. is an amphi-atlantic species, known in Europe from 2 localities only: Lough Mask in Ireland and NE Twente in the Netherlands. The habitat of the species on the western shore of Lough Mask is described with the help of 4 sample plots, and this site is compared with the habitat at Farnham, Quebec, Canada. The Irish habitat is a complicated and rare ecosystem. It occurs on a water-logged sandy soil which is inundated during a major part of the year and poor in lime, mesotrophic and extensively grazed, it presents 4 gradients: a 'macro-gradient' from the calcareous soils east of Lough Mask to the Silurian slates at its western shore; a 'meso-gradient' starting from alternating low sandy ridges, from which sand is blown over marshy depressions; a 'mini-gradient' from depressions poor in humus or running dry for a short time to depressions rich in humus or running dry for a longer time; a 'micro-gradient', being a grazing pattern of tussocks and hollows. *H. canadense* appears to be a long-established native species and not a neophyte. No argument is found in favor of the supposition that a relic species is concerned. The specialized gradient ecosystem which *H. canadense* appears to require in Europe may in itself be a sufficient explanation for its rareness and discontinuous distribution.—Copyright 1971, Biological Abstracts, Inc.

W72-01926

MANAWATU SAND DUNE VEGETATION, Department of Scientific and Industrial Research, Auckland (New Zealand). Botany Div.

A. E. Esler.

N Z Ecol Soc Proc. 17: 41-46. Illus. Map. 1970. Identifiers: Carex-Pumila-M, Desmoschoenus-M, Dune, Leptocarpus-Simulus-M, Limosella-Lineata-D, Lupinus-Arborescens-D, Manawatu, Marram-M, Myriophyllum-Votschii-D, New-Zealand, Pioneers, Ranunculus-Acaulis-D, Sand, Scirpus-Nodosus-M, Selliera-Radicans-D, Spinifex-M, Stabilization, Succession, Vegetation, Wind.

Three vegetational areas are distinguished, the fore dune, the sand plains, and the rear dune. The seaward face of the fore dune is dominated by Spinifex. Marram occurs on the seaward face to a small extent but is more frequent at the top. Desmoschoenus is most vigorous where it regularly gets additional sand. The sand plains are a mosaic of habitats ranging from those of the wet plains to typical dunes. Ridges support marram and Desmoschoenus, low dunes support *Scirpus nodosus* which is replaced by *Leptocarpus simulis* and its associates where the water table is higher. *Lupinus arboreus* is common on the drier parts of the plains. Shallow, damp wind-formed depressions are colonized by sand pioneers, especially *Myriophyllum votschii*, *Limosella lineata*, *Ranunculus acaulis* and *Selliera radicans*. *Carex pumila* may form a girdle around the depression. The rear dunes rise from the terminal sand plains to a maximum of 30-40 ft. The face is usually bare or sparsely vegetated with clumps of Desmoschoenus or marram. Marram is a common stabilizer of the lee.—Copyright 1971, Biological Abstracts, Inc.

W72-01928

DISTRIBUTION OF PLANT COMMUNITIES IN SOUTHEASTERN MONTANA BADLANDS, Intermountain Forest and Range Experiment Station, Logan, Utah.

Ray W. Brown.

Amer Midland Natur. 85 (2): 458-477. Illus. 1971. Identifiers: Agropyron-M, Artemisia-D, Atriplex-D, Badlands, Communities, Distribution, Juniperus-G, Moisture, Montana, Physiography, Pinus-G, Plant, Rhus-D, Sarcobatus-D, Soils.

Vegetation in the badlands of SE Montana was classified into 7 communities, each of which occurs as many widely scattered stands throughout the study area. Vegetation composition, soils and physiographic characteristics in a number of stands of each community were studied and related to community distribution. The Sarcobatus community is the most saline-tolerant type, and occurs on moderate to steep slopes where subsurface soil water moves out to the surface. The Atriplex-Artemisia community is moderately tolerant of saline soils and is restricted to steep slopes of exposed geological strata. The vegetation of this community is mainly concentrated along contouring microbenches resulting from eroded lignite seams. The Artemisia-Atriplex-Agropyron community is restricted to moderate slopes supporting a shallow layer of sandstone talus material, and the closely related Artemisia-Agropyron community is found on more gentle slopes of deeper talus accumulations. Stands of the Rhus-Agropyron community are found principally on outcrops of porcellanite material on moderate to steep slopes, usually near the ridgelines. The Juniperus-Agropyron community is restricted to the more mesic sites in the badlands, primarily in the drainage channels on badland slopes, whereas the Pinus-Juniperus community is restricted to small stands on colluvial knolls at the base of extensive badland slopes. Physiographic and edaphic conditions, insofar as they may influence the availability of soil water, appear to be the principal factors controlling the distribution of badland plant communities.—Copyright 1971, Biological Abstracts, Inc.

W72-01930

Identifiers: Assessment, *Daphnia-cucullata*, *Eudiaptomus-graciloides*, Frequency, *Keratella-cochlearis*, Method, Plankton, Production, Sampling, Species.

The variability of calculated values of production and biomass of 3 spp. (*Eudiaptomus graciloides*, *Daphnia cucullata*, *Keratella cochlearis*) increase in comparison to the value obtained on the basis of frequent daily samples. Great deviations were noticed when the sampling interval is longer than 6 days. Assessments of production and biomass on the basis of the mean parameters for the given sampling interval gave less variable values as compared with the values calculated on the basis of initial parameters. An effect of the character of population dynamics on the relation 'calculated production values-sampling frequency' was noticed. The production values of rotifers calculated according to 3 different methods were compared.—Copyright 1971, Biological Abstracts, Inc.

W72-01933

BIOLOGICAL STUDY OF RAINWATER GATHERING PONDS IN BERLIN, Bundesgesundheitsamt, Berlin (West Germany), Institut fuer Wasser-, Boden-, und Lufthygiene. Bernd-Wulfhard Vorpahl.

Z Ange Zool. 57 (2): 197-210. Illus. 1970.

Identifiers: Algae, Berlin, Biological, Ciliata, Crustaceans, Gathering, Germany, Ponds, Rain, Rotatoria.

The composition of the plankton populations, their seasonal variations and the effect of these variations on life in the Puecklerpfuhl pond (3600 square m) in Gruenewald (Berlin), Forckenbeckteich (7800 square m, Berlin-Wilmersdorf), Wiesenbecker pond (13000 square m, Berlin-Spandau), Dreipfuhl pond (10000 square m, Berlin-Zehlendorf), Lindauer pond (360 square m, Berlin-Reinickendorf), Blanke Helle pond (Berlin-Tempelhof) and in the Friedhofsteich (Berlin-Tempelhof) were determined. Periodically 20 l water samples from each pond were processed, the plankton fixed and counted microscopically. Diagrams were drawn for Copepoda, Cladocera, Rotatoria, Ciliata, Cyanophyceae, Volvocales, Chrysophyceae, Euglenaceae, Dinoflagellatae, Chlorococcales, Conjugales, Heterocontae, Diatomae and Protomonadina. Results of findings in 1965 and 1966 were compared with corresponding findings from 1964.—Copyright 1971, Biological Abstracts, Inc.

W72-01939

FLORISTIC AND VEGETATIONAL SURVEY OF THE CHATTOOGA RIVER GORGE, North Carolina Univ., Raleigh. Dept. of Botany. David M. Dumond.

Castanea. 35 (4): 201-244. Illus. Maps. 1970.

Identifiers: Chattooga, Chestnut, Climate, Floristic, Gorge, Hickory-D, Mesophytic, Mixed, Oak-D, Pine-G, Pitch, River, Scarlet, Survey, Vegetational, White.

Two weather records not heretofore used in climatological evaluations of escarpment gorges are analyzed. A comparison is made between the Chattooga River and other rivers of the escarpment with respect to their relative gradients. Seven broad vegetation types are recognized as characteristic of the Chattooga River Gorge: mixed mesophytic, rare and located in a few northerly oriented coves or river slopes; white pine-mixed deciduous, a successional type; scarlet oak-chestnut oak-hickory, throughout and the most common type; pitch pine-oak: on zeric peaks and ridges with southerly aspect; flood zones along the river; rock outcrops, mesic and zeric phases on granite and disturbed areas. Collections made between May, 1968 and October, 1968 totaled 502 different taxa.—Copyright 1971, Biological Abstracts, Inc.

W72-01932

THE MINERALIZATION ACTIVITY OF BACTERIOPLANKTON IN FRESHWATER ECOSYSTEMS, (IN RUSSIAN), Akademija Nauk Litovskoi SSR, Vilnius. Inst. of Botany.

V. N. Lubianskene, K. K. Yankavichyus, G. Y. Yankavichyute, and T. S. Kiselite.

Tr Akad Nauk Litov SSR Ser V. 2: 15-24. 1970. English summary.

Identifiers: Bacteria, Ecosystems, Fresh, Mineralization, Plankton.

Experiments were carried out to determine the amount of the mineralized organic substances by bacterioplankton in different artificial media which simulate physical and chemical properties of freshwater and in which a complex of planktonic organisms was cultivated. Mineralization process of the organic substances took place intensively. In the course of the experiments the intensity of the mineralization process changed; the smallest amount of mineralized organic substances was observed at the beginning of the experiments (10.3-98 mg/cubic m) while the largest amount took place at the end (6549-6887 mg/cubic m) and after enriching the media with food materials (9552.6 mg/cubic m). The most intensive activity of bacterioplankton in the mineralization process was observed in the medium enriched with food materials having organic substances and in those with increased concentration of mineral substances.—Copyright 1971, Biological Abstracts, Inc.

WATER CYCLE—Field 02

Water in Plants—Group 21

W72-01940

ECOLOGICAL INTERACTION OF BROWN TROUT, *SMALO TRUTTA* L., AND BROOK TROUT, *SALVELINUS FONTINALIS* (MITCHILL), IN A STREAM,
Institute of Freshwater Research, Drottningholm (Sweden).
O. L. Nyman.
Can Field-Natur. 84 (4): 343-350. Illus. Map. 1970.
Identifiers: Brook, Brown, Ecological, Food, Interaction, Pollution, *Salmo-trutta*, *Salvelinus-fontinalis*, Steam, Sympathy, Trout.

Ecological factors involved in the sympatric occurrence of brown trout and brook trout in a stream in southeastern Newfoundland are analyzed. Brook trout were found in the least favorable niches in the pools or in areas of shallow rapids. No sea-run brook trout were encountered, possibly as a result of selection against alleles determining downstream migration. The brook trout population, which was only found in part of the river is probably maintained by involuntary stocking from small tributaries, which are inaccessible to ascending fish. Downstream from the area of sympathy, brook trout are absent possibly because of heavy pollution and upstream (in the absence of restocking from brooks) because of domination and predation by brown trout and differential catchability by anglers. No food segregation between the 2 spp. was apparent in the area of sympatric occurrence, which should favor the larger and sometimes piscivorous brown trout. Food selectivity was low for both species and no species specific trends could be detected. Samples of stomach contents from areas where the species were allopatric displayed that food composition varies obviously with the relative abundance of the food object.—Copyright 1971, Biological Abstracts, Inc.
W72-01949

POPULATION STUDIES ON THE NEW ZEALAND FRESHWATER GASTROPOD, *POTAMOPYRGUS ANTIPODARUM* (GRAY),
Canterbury Univ., Christchurch (New Zealand).
Dept. of Zoology.
M. J. Winterbourn.
Proc Malacol Soc London. 39 (2/3): 139-149. Illus. 1970.
Identifiers: Fresh, Gastropod, Habits, New-Zealand, Population, *Potamopyrgus-antipodarum*, *Potamopyrgus-jenkensis*, Reproductive.

Studies were made on 3 populations of *P. antipodarum*, 2 in small ponds and the 3rd in a lowland stream, over a 13-14 mo. period. Small numbers of males were present in the stream population but all pond snails were parthenogenetic females. Size structure of the 3 populations was examined each month. Throughout the year the stream population was dominated by large numbers of small individuals, whereas both ponds contained large numbers of adult snails in most months. Differences in population size structure probably reflect a higher mortality rate in the stream, brought about primarily by its harsher physical environment. Draining and cleaning of the ponds in winter seriously reduced the number of snails but did not eliminate the populations. Each month in the stream, a far smaller percentage of adult snails (shell height S 3.5 mm) contained embryos than in the ponds. No seasonal changes in the percentage of reproductively active adult snails were found in the ponds, but in the stream a higher proportion of adults contained embryos in late spring and early summer. The number of embryos present in the brood pouches of individual snails varied seasonally, maximum numbers occurring in spring in the ponds, and in summer in the stream. Rearing of snails in the laboratory indicated that reproductive age may be attained in 6 mo., and the release of embryos can occur after 9 mo. No significant differences in the reproductive cycles of *P. antipodarum* and the European species *P. jenkensis* were found.—Copyright 1971, Biological Abstracts, Inc.
W72-01950

THE DISTRIBUTION OF SPECIES OF THE GENUS RIVULOGAMMARUS IN FLOWS OF NORTHERN BADEN AND SOUTHERN WUERTTEMBERG,

Landesstelle Gewässerkunde, Baden-Württemberg (West Germany).
Wulf Besch.
Beit Naturkundlichen Forsch Sudwestdeut. 27 (1): 27-33. Maps. 1968.
Identifiers: *Asellus*, Baden, Distribution, *Echinogammarus-Berilloni*, Flows, Genus, Germany, Indicators, Northern, Pollution, *Rivulogammarus*, *Rivulogrammus-Fossarum*, *Rivulogrammus-Pulex*, *Rivulogrammus-Roseseli*, Southern, Species, Württemberg.

The habitats of *R. fossarum*, *R. pulex*, *R. roseseli* and *Echinogammarus berilloni* were plotted on a map of the region. While *R. fossarum* is a typical limnofauna of the region, brooks of the region are mostly populated with *R. roseseli*, *R. pulex*, confined to the Danube and Rhine basins, is spreading fast. The absence of these species in certain waters can be attributed to pollutants and the species are thus sensitive indicators. They do not grow in a water with a lower than 4 mg/IO₂ content and cannot tolerate drifting suspended organic and inorganic particles. In heavily polluted waters *Asellus* was found to replace *Gammaridae*.—Copyright 1971, Biological Abstracts, Inc.
W72-01952

STUDIES ON THE AQUATIC INSECT COMMUNITY OF MOUNTAIN STREAM AT THE FOOT OF MT. DAISEN: I. ECOLOGICAL INVESTIGATION ON A POPULATION OF EPHemeropERA (JAPANESE),

Tottori Univ. (Japan). Faculty of Education.
Yoshinori Ondo, Mieko Kobayashi, and Kimie Tanigawa.

J Fac Educ Tottori Univ Natur Sci. 20 (2): 104-129. Illus. Map. 1969. English summary.

Identifiers: Aquatic, Community, Daisen, Dipetromimus-Tripuliformis, *Ecdyonurus-Kubanensis*, *Ecdyonurus-Tobiirostris*, Ecological, *Epeorus-Latifolium*, *Ephemerina-Japonica*, *Ephemerina-Lineata*, *Ephemerella-Trispina*, *Ephemeroptera*, Foot, Insect, Mount, Mountain, Population, Stream.

In 1966, ecological studies on the aquatic insect community were carried out from March to Nov. Sampling was done once a month at the 5 stations in mountain stream which in the outlet of Ono-ike water reservoirs at the foot of Mt. Daisen. Data on the population dynamics of *Ephemeroptera* are given. Noticeable relationships were observed between the species composition of mountain stream and that of Mt. Hyonosen, Hyogo Prefecture reported by Nishimura in 1960. For example, *Ecdyonurus tobiirostris*, *Ephemerina japonica*, *Dipetromimus tripuliformis*, *Ephemerella trispina*, *Epeorus latifolium*, and *Ecdyonurus kubanensis* were common to both mountain stream and Mt. Hyonosen. In the upper stream section, larvae of burrowing forms were dominant in individual numbers and standing crop, while creeping and swimming forms were dominant in the downstream section. Interestingly, *Ephemerina lineata* was found in the source of an outlet at an altitude of 450 m.—Copyright 1971, Biological Abstracts, Inc.
W72-01953

THE FRESHWATER FISHES OF GEORGIA,

Georgia Univ., Athens. Dept. of Zoology.
Michael D. Dahlgren, and Donald C. Scott.
Bull Ga Acad Sci. 29 (1): 1-64. Map. 1971.
Identifiers: Fishes, Fresh, Georgia, Habitats, Species.

The known freshwater fishes of Georgia comprise 209 spp. in 22 families. Eight additional spp. possibly occur in Georgia. A high diversity of freshwater fishes in Georgia is related to the number of drainage systems (10 are considered), variety of habitats and relatively large size of the state. The 3 drainage basins in Georgia are the Atlantic Ocean, Gulf of Mexico, and Tennessee River (Ohio River

Basin) with 114,147, and 78 spp. recorded, respectively. The Tennessee River drainage occupies a relative small area of Georgia. Numbers of species recorded for 6 major drainage systems are as follows: Tennessee (80), Mobile Bay (89), Apalachicola (97), Suwannee (52), Altamaha (93), and Savannah (102). These numbers include known and probably introductions which number 7, 7, 14, 0, 10, and 14, respectively. Distribution patterns are determined primarily by the isolation of drainage systems, availability of dispersal routes, and by habitat preferences, especially in relation to the physiographic provinces. For each species are analyzed the distribution in Georgia, relative abundance, and all relevant literature.—Copyright 1971, Biological Abstracts, Inc.
W72-01955

STUDIES ON PLANT-WATER RELATIONSHIPS. V. INFLUENCE OF SOIL MOISTURE ON PLANT PERFORMANCE AND NITROGEN STATUS OF THE SHOOT TISSUE,

Central Arid Zone Research Inst., Jodhpur (India).
A. N. Lahiri, and Sudama Singh.

Proc Indian Nat Sci Acad Part B Biol Sci. 36 (2): 112-125. Illus. 1970.

Identifiers: Moisture, Nitrogen, *Pennisetum-Typhoides-M*, Performance, Plant, Relationships, Shoot, Soil, Tissue.

Three *Pennisetum typhoides* cultivars, 'Hybrid', 'RSK' and 'T55', were subjected to different moisture regime by watering to field capacity when the soil moisture tension increased to 1, 8 and 15 atm respectively. Plants maintained at field capacity served as control. The changes in the various characters of plants, the concentration and the absolute quantities of total, soluble and protein N contents of the shoot tissue at successive stages of growth, the N uptake rates and the grain N status are described. Vegetative growth was maximum in 'RSK' but 'Hybrid' showed the highest yield. Yield was depressed equally in all varieties under the 15 atm regime by 'Hybrid' displayed superiority over others between the range of field capacity and 8 atm regime. Decrease in soil moisture brought about an increase in the N concentration of the shoot tissue at all stages of growth. There was a general decline in concentration with the age of the plant. A marked decrease in the absolute N content/plant, and in the N uptake rate, was noticed under 15 atm regime. Two distinct peak periods of N uptake occurred. The relative demands for N of these varieties at their different developmental stages are outlined. Decreased in soil moisture increased the N content of the grains although the yield was adversely affected.—Copyright 1971, Biological Abstracts, Inc.
W72-02163

ON THE QUESTION OF THE POLLINATION BY RAIN (OMBROGAMY),

Karlova Universita, Prague (Czechoslovakia).
Dept. of Botany.

Erich Daumann.
Preslia (Praha). 42 (3): 220-224. 1971.
Identifiers: *Caltha-Palustris-D*, Injury, *Narthecium-Ossifragum-M*, Ombrogamy, Pollen, Pollination, Rain, *Ranunculus-Repens-D*, Stigma.

The author doubts the possibility of the pollination by rain, given by Hagerup for *Ranunculus repens*, *Caltha palustris* and *Narthecium ossifragum*, because each of these species has pollen and stigma highly susceptible to water which injures both of these organs. Therefore, he regards the term 'ombrogamy' as unjustified.—Copyright 1971, Biological Abstracts, Inc.
W72-02184

POPULATIONS FLUCTUATIONS IN THE GENUS TRACHELOMONAS (ORDER EUGLENIDA),

North Carolina Univ., Asheville. Dept. of Biology.
John J. McCoy.

J Elisha Mitchell Sci Soc. 86 (4): 198-202. Illus. 1970.

Field 02—WATER CYCLE

Group 21—Water in Plants

Identifiers: Euglenida, Fluctuations, Genus, Populations, Trachelomonas.

In 1968 a preliminary study was begun on the kinds, distribution, and ecology of euglenoids of western North Carolina. This paper represents a compilation of data on population changes in the Genus Trachelomonas and an attempt to correlate such changes with inorganic N sources.—Copyright 1971, Biological Abstracts, Inc.
W72-02189

AN EXPERIMENTAL APPROACH TO THE PRODUCTION DYNAMICS AND STRUCTURE OF FRESHWATER ANIMAL COMMUNITIES, Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.

Donald J. Hall, William E. Cooper, and Earl E. Werner.

Limnol Oceanogr. 15 (6): 839-928. Illus. 1970. Identifiers: Animal, Communities, Dynamics, Fish, Fresh, Macrophytes, Plankton, Predation, Production, Structure.

The effects of 3 levels of inorganic nutrients and 2 predator densities on aquatic animal communities were examined in a series of twenty 0.07-ha freshwater ponds. The treatments were cross-classified in a randomized block design and continued over 3 yr. Analyses of the responses include community composition, secondary production, and demographic description of the dominant species of both zooplankton and benthos. The fish populations and their feeding behavior are described in detail. Ancillary data on water chemistry and primary production were available. Nutrients generally increased production of the zooplankton but had little effect on community composition. Fish predation had profound effects on the diversity and size distribution of the zooplankton but only affected production at lower nutrient levels. The benthos responded markedly to nutrients during the 1st yr, but this was not apparent the 2nd and 3rd years. The response of the benthos to both nutrients and predation was best shown by changes in the distribution of body size. Both zooplankton and benthic communities showed complementary responses between large- and small-bodied organisms. Differences in the physical structure of the environment (i.e., macrophytes) also produced significant changes in production and composition of both systems. The biomass production of the fish populations was clearly related to nutrient level. Both fish and invertebrate predators were size selective, but the fish had a much greater influence on the prey populations.—Copyright 1971, Biological Abstracts, Inc.
W72-02192

EVALUATION OF A KICKING TECHNIQUE FOR SAMPLING STREAM BOTTOM FAUNA, Memorial Univ. of Newfoundland, St. John's. Dept. of Biology.

S. Frost, A. Huni, and W. E. Kershaw. Can J Zool. 49 (2): 167-173. Illus. 1971. Identifiers: Bottom, Fauna, Invertebrates, Kicking, Sampling, Stream, Technique.

A square-framed, conical net (300-micro pores) was used in the kicking technique described herein for sampling the larger invertebrates of stony streams. Small samples have consistent percentage population components differing significantly from large ones. Even when bottom-dwellers are numerous, less than 20% of those present are collected (including less than 5.4% of the truly lithophilic species). Almost 60% of the fauna collected from any one site is taken at the 1st kick. Three kicks yield almost 90% of the organisms secured by 10. Some organisms bypass the net or swim from or through it, and if the net is maintained in position for any length of time, stream-drift animals will mask the sample.—Copyright 1971, Biological Abstracts, Inc.
W72-02194

A PERMANENT RECORD OF PLANKTON SAMPLES USING HOLOGRAPHY, California Univ., San Diego, La Jolla. Inst. of Marine Research. John R. Beers, Cameron, Knox, and John D. H. Strickland. Limnol Oceanogr. 15 (6): 967-970. Illus. 1970. Identifiers: Holography, Permanent, Plankton, Record, Samples.

Holograms provide a convenient means for keeping a permanent record of microplankton samples which can then be re-examined as desired. While resolution is not as good as with conventional optical systems, it is generally possible to identify organisms having 1 dimension in excess of about 30 micron.—Copyright 1971, Biological Abstracts, Inc.
W72-02202

AGROSTIDETUM STOLONIFERAE (MOOR 1958) OBERD. ET TH. MULLER 1961 ON THE LITTORAL OF THE POPRAD RIVER (IN CZECHOSLOVAKIA).

Ceskoslovenska Akademie Ved, Bratislava. Botanicky Ustav, Slovenská Akademie věd, Bratislava (Czechoslovakia). Botanical Inst. Marica Zaliberova. Biolog. (Bratislava). 25 (10): 691-698. Illus. 1970. English summary. Identifiers: Agrostidetum-Stoloniferae, Agrostis-Stolonifera-M, Barbara-Vulgaris-D, Czechoslovakia, Littoral, Poprad, River, Rorippa-Sylvestris-D.

Growth of Rorippa (sylvestris) association-Agrostidetum stoloniferae gradually cover the gravel banks islets and islands with thin unbroken layers of fine soil and high water tables. The characteristic associations here are the Agrostis stolonifera, A. stoloifera sp. gigantea, Barbara vulgaris and Rorippa sylvestris.—Copyright 1971, Biological Abstracts, Inc.
W72-02206

A CRITIQUE OF THE CONCEPT OF GROWING SEASON, Hawaii Univ., Honolulu. Dept. of Geography.

For primary bibliographic entry see Field 03F.
W72-02211

TREE-RING DATING OF COLORADO RIVER DRIFTWOOD IN THE GRAND CANYON, Arizona Univ., Tucson. Lab. of Tree-Ring Research.

For primary bibliographic entry see Field 07B.
W72-02234

RELATION BETWEEN BEGINNING OF EMERGENCE OF ODONATES, DEVELOPMENT OF LEAVES IN SPRING, AND WATER TEMPERATURE STUDIES: READING, UK, JULY 23-30, 1966, L. Fernet, and J. Pilon.

Phytophotography. 51 (3): 1970. 148. Identifiers: Development, Emergence, Leaves, Odonates, Relation, Spring, Temperature.
W72-02246

DOLPHIN FEEDING OUT OF WATER IN A SALT MARSH, H. D. Hoese.

J Mammalogy. 52 (1): 1971. 222-223. Identifiers: Bairdiella-Chrysura, Dolphin, Feeding, Leiosomus-Xanthurus, Marsh, Salt, Tursiops-Truncatus.
W72-02247

DRIFT PERIODICITY AND UPSTREAM DISPERSION OF STREAM INSECTS, M. A. Brusven.

J Entomol Soc Brit Columbia. 67: 1970. 48-59.
W72-02195

Identifiers: Dispersion, Drift, Insects, Larvae, Mayfly, Nymph, Periodicity, Plecoptera, Sigara-Grossolineata, Simulium, Stream, Trichoptera, Upstream.
W72-02248

2J. Erosion and Sedimentation

CONTROL OF BENTHIC DEPOSITS IN LAKES, Massachusetts Univ., Amherst. Dept. of Civil Engineering.

For primary bibliographic entry see Field 02H.
W72-01699

EVIDENCE OF CIRQUE GLACIATION IN THE FALKLAND ISLANDS, Aberdeen Univ. (Scotland). Dept. of Geography.

C. M. Clapperton. Journal of Glaciology, Vol 10, no 58, p 121-125, 1971. 3 fig, 5 ref.

Identifiers: *Cirques, *Glaciation, *Pleistocene epoch, *Geomorphology, Paleoclimatology, Regimes, Climates, Glaciers, Erosion, Glacial drift. Identifiers: *Falkland Islands.

Cirques on the Falkland Islands were caused by glacial conditions during the Pleistocene. Cirque moraines and glacially eroded valleys also occur. Three phases are proposed: a period of cirque formation, the growth of local ice caps, and subsequent cirque development. Periglacial landforms such as stone runs, stone terraces and stone lobes also developed during the Pleistocene and attained very large dimensions because of the lithology, the relatively small scale of glaciation and the presence of rotted bedrock. (Knapp-USGS).
W72-01713

CORRECTIVE TERMS IN THE GLACIOLOGICAL BALANCE, Centre National de la Recherche Scientifique, Grenoble (France). Laboratoire de Glaciologie.

For primary bibliographic entry see Field 02C.
W72-01715

BEDROCK WEATHERING AND RESIDUAL SOIL FORMATION IN CENTRAL VIRGINIA, Virginia Highway Research Council, Charlottesville.

R. W. Plaster, and W. C. Sherwood. Geological Society of America Bulletin, Vol 82, No 10, p 2813-2826, October 1971. 14 fig, 3 tab, 28 ref.

Identifiers: *Weathering, *Soil formation, *Virginia, Soil horizons, Clay minerals, Soil types, Soil profiles, Soil chemistry, Soils, Mineralogy.

Three residual soil profiles in central Virginia studies for textural, mineralogical, and chemical relations to bedrock are Frederick soil overlying the impure Chepultepec limestone; Iredell soil overlying and unnamed hornblende gabbro; and Lloyd soil overlying the Robertson River granite gneiss. Many of the characteristic properties of the overlying soil profile can be related directly to the type of underlying bedrock. Frederick soil is largely homogeneous with only subtle profile development. The Iredell profile, while quite shallow and apparently immature, is composed of a saprolitic C horizon overlain by a well-developed clay-rich B horizon that is in turn, overlain by a highly leached A horizon. The Lloyd soil is classically stratified except for the leached A horizon that was apparently removed by erosion. The Frederick soil contains the most clay size material while the Iredell and Lloyd have high clay contents only in the B horizon. The Iredell and Lloyd soils yield high percentages of sand particles in the C horizon due to the saprolitic nature of the partially weathered gabbro and gneiss. Different species of clay minerals predominate in each of the three soils as follows: illite—Frederick; vermiculite, illite, and montmorillonite—Lloyd.

WATER CYCLE—Field 02

Erosion and Sedimentation—Group 2J

ionite—Iredell; and kaolinite—Lloyd. Each of the three soil/rock systems studied differs significantly from the others, and each reflects the mineralogy and texture of the parent bedrock in a generally predictable manner. (Knapp-USGS)
W72-01716

DRAINAGE DENSITY, LENGTH RATIOS, AND LITHOLOGY IN A GLACIATED AREA OF SOUTHERN CONNECTICUT,
Columbia Univ., New York. Dept. of Geology.
L. Wilson.
Geological Society of American Bulletin, Vol 82, No 10, p 2955-2956, October 1971. 1 tab, 6 ref.

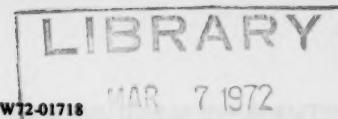
Descriptors: *Drainage patterns (Geologic), *Drainage density, *Geomorphology, *Connecticut, Geologic control, Glacial drift, Statistical methods, Glaciation, Erosion.
Identifiers: Stream length ratios.

Drainage density averages 8.08 mi of channel per sq mi of third-order basin for the quadrangle as a whole. A very strong relationship exists between drainage density and lithology, despite the influence of glaciation. There is no evidence that the drainage in any way reflects earlier erosion cycles, unless these cycles involved adjustment of drainage to rock type. Altitude increases as drainage density decreases. Resistant lithologies produce a landscape with a drainage density of 5 to 7, and maximum elevations over 800 ft, while weaker units result in a drainage density of more than 7, and maximum elevations less than 700 ft. The mantle of glacial drift is thin. Many second and third order channels flow on bedrock, and outcrops are common in summit regions. Drainage density is closely adjusted to rock type in the Mount Carmel quadrangle, Connecticut, despite the influence of glaciation and past erosion cycles. Total length ratio varies significantly with lithology while mean length ratio, which has a stochastic component, does not. (Knapp-USGS)
W72-01717

GRAND ISLE: A BARRIER ISLAND IN THE GULF OF MEXICO,
Peltz Oil Co., New Orleans, La.
W. E. Conatser.
Geological Society of America Bulletin, Vol 82, No 11, p 3049-3068, November 1971. 19 fig, 58 ref.

Descriptors: *Sand bars, *Gulf of Mexico, *Louisiana, *Deltas, *Sand spits, Coasts, Geomorphology, Sedimentation, Beaches, Provenance, Sediment transport, Waves (Water), Particle size, Mineralogy, Sands.
Identifiers: Grand Isle (Louisiana).

Grand Isle, Louisiana, is a barrier island composed entirely of sediments, most of which are terrigenous. Surface sediments of the island are primarily fine- to very fine-grained sand, some silt and some clay. Size characteristics of the sediments parallel geomorphic features such as the beach, dune, back-island ridges, and inter-ridge areas. Silt and clay fractions of the sediment generally increase behind the dune complex of the island. The finer fraction is secondarily introduced from the bay-sound environment by influxes of high water and by aeolian transport. Two factors indicate that beach material moves into the Grand Isle are via littoral currents from the southwest: (1) all grain-size characteristics of beach material increase to the southwest; and (2) sediment buildup occurs on the southwest sides of the jetty and groins. Approximately 25 sets of relict beach and dune ridges are present behind the active beach dunes. The orientation of these low relief back-island features indicates that the island has grown at its distal ends and seaward by accretion. The island originated as a barrier spit which extended northeastward from the Mississippi River delta front. The barrier spit was separated from the mainland by a tidal current breakthrough or surge of storm waters. Since separation from the mainland, the island has grown at each end, and seaward, by ridge accretion. (Knapp-USGS)



PACIFIC POWER & LIGHT
TERRACES AND PEDIMENT-TERRACES IN THE SOUTHWEST: AN INTERPRETATION,
Arizona State Univ., Tempe. Dept. of Geology.

C. F. Royce, Jr., and D. Barchs.
Geological Society of American Bulletin, Vol 82, No 11, p 3177-3181, November 1971. 4 fig, 23 ref.

Descriptors: *Terraces (Geological), *Paleoclimatology, *Erosion, *Geomorphology, *Southwest U. S., Slopes, Topography, Surfaces, Arizona, Land forming, Alluvium, Arid lands.
Identifiers: *Terraces.

Both fluvial terraces and pediment-terraces (defined as pediment-like surfaces cut in soft rock) occur together, within the same drainage basins, throughout the Southwest. In the Tonto Basin of central Arizona are seven distinct terraces and five pediment-terraces that range from 20 to nearly 1,000 ft above the present flood plain of Tonto Creek. These two types of surfaces do not grade into one another, but are products of different erosional episodes. Tectonic hypotheses do not account for either the regional distribution of pediment-terraces or their alternation with fluvial terraces. A climatic origin is probable; pediment-terraces are products of arid episodes and terraces are products of more humid episodes. They probably correlate with interpluvials and pluvials of the Pleistocene. (Knapp-USGS)
W72-01719

CHANNEL STABILITY IN THE ESTUARY: CONTROLS BY BEDROCK AND UNCONSOLIDATED POST-GLACIAL SEDIMENT,
Dundee Univ., Newport-on-Tay (Scotland). Tay Estuary Research Center.
For primary bibliographic entry see Field 02L.
W72-01721

A METHOD OF MONITORING MUDFLOW MOVEMENTS,
Queen's Univ., Belfast (Ireland). Dept. of Geography.
D. B. Prior, and N. Stephens.
Engineering Geology, Vol 5, No 3, p 239-246, October 1971. 4 fig, 10 ref.

Descriptors: *Mudflows, *Mass wasting, *Monitoring, *Landslides, *Rainfall intensity, Soil water, Erosion, Clays, Expansive soils.
Identifiers: Ireland.

The configuration of mudflow sites favors the installation of mechanical recorders because the junction between moving mud and the adjacent slopes is extremely sharp. The margins of the flow tracks are represented by near-vertical, planar shear surfaces. The continuous monitoring technique supplements weekly observations of mudflows in northeastern Ireland. It yields information on amounts of movement and variations of the movement patterns through time. The technique may be used in conjunction with the continuous recording of possible causative factors, such as rainfall, to indicate the conditions under which instability is initiated and maintained. Of particular interest are some short periods of very rapid movement. These are represented by steeply inclined or vertical sections on the recorder trace. Each of these is followed by a short period of relative stability where the trace is horizontal. Thus, it seems that a short-lived surging movement is also an important component of the mudflow activity. In each case the surge period culminates in one single, pronounced rapid displacement. The mudflow surges frequently accompany periods of rainfall or closely follow after them. In particular, a 19.8 cm surge followed a total of 20 mm of rainfall in the previous 11 hours. Within this rain storm there were two periods of high rainfall intensity. The largest surge occurred one hour after the intense rainfall. (Knapp-USGS)
W72-01722

INTERACTION OF ROTATING ELEMENTS OF THE BOUNDARY LAYER WITH GRAINS OF A BED; A CONTRIBUTION TO THE PROBLEM OF THE THRESHOLD OF SEDIMENT TRANSPORTATION,
Eidgenoessische Technische Hochschule, Zurich.
Lab. of Hydraulic Research and Soil Mechanics.
A. Muller, A. Gyr, and T. Dracos.
Journal of Hydraulic Research, Vol 9, No 3, p 373-411, 1971. 18 fig, 1 tab, 15 ref, 2 append.

Descriptors: *Turbulent flow, *Sediment transport, *Vortices, *Hydraulic models, *Tractive forces, Bed load, Hydrodynamics, Hydraulics, Shear drag, Rotational flow, Turbulence.
Identifiers: *Hydrodynamic lift.

The forces exerted by a rotating fluid element of a turbulent flow field on a grain of sediment are sufficient to explain the threshold of transportation. Transportation does not begin until the ratio between lift and submerged weight reaches a lower limit which depends on the deposition of the grain. For a typical bed configuration this limit is 0.7. To simulate the interaction between a rotating fluid element and a grain sediment, the forces of a potential vortex on an embedded sphere were measured in a model. When the measured forces are correlated with measurements of pressures in the boundary layer, lift is within the range needed to initiate movement. (Knapp-USGS)
W72-01727

SHAPES OF GRIT CHAMBERS TO ACHIEVE CERTAIN VELOCITY-HEAD RELATIONS WITH GIVEN SHAPES OF OUTLET WEIRS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
For primary bibliographic entry see Field 08B.
W72-01729

HEAVY MINERALS OF NORTHERN SAND KEY, PINELLAS COUNTY, FLORIDA,
Southern Illinois Univ., Carbondale. Dept. of Geology.
W. C. Hood, S. D. Hood, and S. M. Oleson.
Southeastern Geology, Vol 13, No 3, p 187-198, October 1971. 4 fig, 3 tab, 7 ref.

Descriptors: *Sand bars, *Mineralogy, *Distribution patterns, *Sedimentation, *Florida, Sands, Beaches, Sediment transport, Beach erosion, Surf, Waves (Water), Particle size, Particle shape, Specific gravity.
Identifiers: *Heavy minerals (Sands), Sorting, Sand Key (Fla.).

Beach sands of Sand Key, Florida, contain a suite of 14 heavy minerals, concentrations of which reach 30% in a half-mile long area near the northern end of the beach. Ilmenite, staurolite, garnet, and zircon are the most common detrital heavy minerals along most of the beach with zircon reaching nearly 10% in the zone of concentration. Heavy mineral abundances in the zone of concentration are mainly a function of specific gravity with some influence shown by grain shape. Large concentrations of heavy minerals are associated with small grain diameters of quartz. Wave erosion has selectively removed quartz, especially the larger grain size, and left a residue of the more dense heavy minerals and smaller grain sizes of quartz. (Knapp-USGS)
W72-01732

SALINE WATERS: GENESIS AND RELATIONSHIP TO SEDIMENTS AND HOST ROCKS,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
For primary bibliographic entry see Field 02K.
W72-01755

DISPERSAL PATTERNS OF CLAY MINERALS IN THE SEDIMENTS OF THE EASTERN MEDITERRANEAN SEA,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
K. Venkataraman, and W. B. F. Ryan.

Field 02—WATER CYCLE

Group 2J—Erosion and Sedimentation

Marine Geology, Vol 11, No 4, p 261-282, November 1971. 1 fig, 4 tab, 36 ref. NSF Grant No GA-580 ONR Contract N-00014-67A-0108-0004.

Descriptors: *Clay minerals, *Clays, *Distribution patterns, *Provenance, Ocean currents, Sediment transport, Streamflow, Ocean circulation, Deposition (Sediments), Bottom sediments, Suspended load.

Identifiers: *Mediterranean.

Six mineral assemblages have distinctive sources and their dispersal reflects different agents of transport in the eastern Mediterranean Sea. A Nile assemblage with large amounts of well-crystallized smectite (over 50%) and 15-25% kaolinite is found on the eastern Nile cone and within the eastern Levantine Basin. Its distribution results from dispersal by easterly currents which form part of the counter-clockwise gyre in the eastern Mediterranean. A southeast Aegean assemblage transported by Levantine Intermediate water is characterized by 40-60% well-crystallized smectite and higher contents of chlorite and illite than in the Nile assemblage. A kaolinite-rich assemblage (20-30% kaolinite), coinciding with high carbonate values, occurs on the western section of the Mediterranean ridge and in the western Nile cone, as a consequence of transport by wind from North Africa. The restriction of Kithira and Messina assemblages (illite- and chlorite-rich assemblages) to deep parts of the Ionian Basin is chiefly due to water movements involved in deep circulation. A Sicilian assemblage with 20-30% kaolinite and 30-50% smectite in the westernmost part of the Ionian Basin south of Sicily is caused by dispersal by eastward moving surface waters. (Knapp-USGS)

W72-01999

HEIGHT OF SAND DUNES IN OPEN CHANNEL FLOWS,

Ministry of Natural Resources, Sokoto (Nigeria).

M. A. Gill.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY12, Paper 8612, p 2067-2074, December 1971. 2 fig, 14 ref, append.

Descriptors: *Sand waves, *Dunes, *Bed load, *Sediment transport, *Mathematical models, Froude number, Hydraulic models, Open channel flow, Alluvial channels, Channel morphology.

Equations were deduced for maximum height of sand dunes in open channel flows using kinematic and dynamic approaches. The final result obtained by the dynamic approach is essentially similar to that obtained from the kinematic approach; the only difference is due to a term including Froude number in the dynamic approach. An assumption had to be made that the hydraulic resistance of the alluvial bed remains invariant with respect to velocity. (Knapp-USGS)

W72-02021

ALEUTIAN PLAIN SEDIMENTS AND LITHOSPHERIC PLATE MOTIONS,

Lamont-Doherty Geological Observatory, Palisades, N. Y.

E. J. W. Jones, J. Ewing, and M. Trueman. Journal of Geophysical Research, Vol 76, No 33, p 8121-8127, November 20, 1971. 3 fig, 21 ref. ONR Contract N00014-67-A-0108-0004.

Descriptors: *Sedimentation, *Atlantic Ocean, *Structural geology, *Turbidity currents, Stratigraphy, Sediment transport, Provenance, Profiles, Sounding, Pacific Ocean, Topography.

Identifiers: Aleutian abyssal plain.

The relict Aleutian abyssal plain consists of two tongues of well-stratified sediments deposited from turbidity currents which entered the region from a northerly direction. The distribution of the turbidites appears to have been largely governed by a topographic grain imparted to the basement surface by Late Cretaceous-Paleocene plate motions. The last channelized routes of turbidity current flows to the southern portion of the area were

severed during the Late Miocene, and since then only pelagic sediments have accumulated. The change in the depositional regime can thus be associated in time with the change in the direction of sea-floor spreading in the northeastern Pacific and to the start of a period of severe deformation in southern Alaska. The pattern of sedimentation and the time at which the Aleutian plain became isolated from its source of terrigenous sediments are both consistent with models recently proposed for plate motion in the northeastern Pacific since the close of the Mesozoic. (Knapp-USGS).

W72-02043

SEDIMENT TRANSPORTATION MECHANICS: FUNDAMENTALS OF SEDIMENT TRANSPORTATION.

American Society of Civil Engineers, New York. Task Committee on Preparation of Sedimentation Manual.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY 12, Paper 8591, p 1979-2022, December 1971. 26 fig, 2 tab, 79 ref.

Descriptors: *Sediment transport, *Sedimentation, *Reviews, Alluvial channels, Sedimentary structures, Sediment load, Water temperature, Channel morphology, Hydraulic models, Bed load.

Some of the basic ideas and findings upon which knowledge of sedimentation is based are reviewed. Considerable reliance is placed directly on results of field and laboratory investigations because theoretical approaches have had only limited success in dealing with many of the complex phenomena involved. Bed forms are discussed theoretically and compared with some data on natural bed forms. Basic concepts on which theories of sediment transportation are based are discussed and some observed relations not explained by the theories are presented. Data and ideas on the comparative sizes of bed sediment and sediment load are presented and discussed in the light of stream-bed armoring. The effect of water temperature on sediment movement is also discussed. (Knapp-USGS).

W72-02059

CONTROL OF SEDIMENTS RESULTING FROM HIGHWAY CONSTRUCTION AND LAND DEVELOPMENT,

Environmental Protection Agency, Washington, D.C. Office of Water Programs.

R. E. Thronson.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$0.60. EPA Office of Water Programs Report, September 1971. 50 p, 38 fig, 45 ref.

Descriptors: *Sediment control, *Environmental effects, *Accelerated erosion, *Deposition (Sediments), *Sediment yield, Sediment transport, Road construction, Land development, Water pollution sources, Water supply, Damages, Water pollution effects.

Accelerated erosion of soils and excess deposition of sediments resulting from construction activities have caused pollution of water bodies in many parts of the country, damaged homes and drainage systems, made treatment of water supplies very costly, and adversely affected aquatic life. The technical capability of controlling these processes is available and the cost minimal. The principal problem lies in achieving effective administrative control and enforcement by concerned agencies. (EPA abstract)

W72-02106

OPTICAL FOURIER TRANSFORM TECHNIQUE FOR MEASURING SEDIMENT CONCENTRATION,

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

A. McSweeney.

Paper, Second Coastal and Shallow Water Conference, October 9 and 10, 1971, University of Delaware, Newark. 13 p, 9 fig, 4 ref. OWRR A-027-GA (2).

Descriptors: *Turbidity instrumentation, *Turbidity, *Sediments, *Sediment distribution, *Particle size, Optical measurement, Particle shape, Optical properties, Water pollution, Fourier analysis, Light intensity, Opacity.

Identifiers: *Fiber-optics, *Light-pipes.

Optical transformation techniques using a laser for illumination were investigated to measure sediment concentration in a water sample. An optical Fourier transformation system was set up with a bundle of fiber-optic light-pipes connected to an array of photo detectors for analyzing the transform of samples of known particle size distribution. Two of seven information channels of the fiber-optic bundle were used as a test. Intensity measurements from the test of two known monodisperse samples were used to generate a matrix of weight functions. The matrix was used to transform the measured intensity from a mixture containing two particle sizes which were different from the sizes used to determine the matrix. Results show that the system could not distinguish between 160 and 187 micrometer diameter particles but discriminated well between 276 and 321 micrometer diameter particles. Both size resolution and accuracy are expected to improve as more fiber-optic channels are used. (Conway-Georgia Tech).

W72-02158

SHEET EROSION ON FOREST SOILS,

H. W. Chambers.

Queensland Agr J. 96 (11): 1970. 758-760.

Identifiers: Erosion, Forest, Sheet, Soils.

W72-02249

2K. Chemical Processes

WATER GEOCHEMISTRY OF MINING AND MILLING RETENTION IN THE 'NEW LEAD BELT' OF SOUTHEAST MISSOURI,

Missouri Univ., Rolla. Water Resources Research Center.

For primary bibliographic entry see Field 05B.

W72-01692

PREDICTING VARIATIONS IN ENERGY FLOW THROUGH A SEMI-CONTROLLED LOTIC ECOSYSTEM,

Michigan State Univ., East Lansing. Kellogg Biological Station.

For primary bibliographic entry see Field 02I.

W72-01701

BEDROCK WEATHERING AND RESIDUAL SOIL FORMATION IN CENTRAL VIRGINIA,

Virginia Highway Research Council, Charlottesville.

For primary bibliographic entry see Field 02J.

W72-01716

CHEMICAL WEATHERING OF THE BISCAYNE AQUIFER, DADE COUNTY, FLORIDA,

Colorado Univ., Boulder. Dept. of Geological Sciences.

For primary bibliographic entry see Field 02F.

W72-01731

LONG TERM MOVEMENT OF WATER AND SOIL SALINITY IN THE WEATHERING ZONE OF ARID ZONE SEDIMENTS,

New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry.

For primary bibliographic entry see Field 02G.

W72-01753

WATER CYCLE—Field 02

Chemical Processes—Group 2K

A SURVEY OF SALINE GROUND WATER AS A MINERAL RESOURCE, New Mexico Bureau of Mines and Mineral Resources; and New Mexico Inst. of Mining and Technology, Socorro.

W. K. Summers, and G. E. Schwab.

In: *Saline Water*, Mattox, R. B. (ed.), AAAS, Committee on Desert and Arid Zone Research, Contribution No 13, p 31-45, 1970. 1 tab, 7 ref.

Descriptors: *Saline water systems, *Groundwater basins, *Mineral water, *Brines, Thermal water, Sedimentary basins (Geological), Geologic investigations, Dissolved solids, California, New Mexico.

Identifiers: *Hydrometallurgy.

Saline ground water has often been exploited as a source of fresh water with waste mineral byproducts, but this concept has gradually changed into one of mining for mineral value with potable water as a bonus. Various definitions and classifications of saline water are reviewed. In general, saline ground waters occur in only a few geologic settings: sedimentary basins, structural troughs, thermal areas and miscellaneous isolated areas. Waters currently used for their mineral content are brines (35,000 ppm dissolved solids), but improved technology should facilitate the exploitation of saline waters of lower concentrations. Because hot water is a more effective solid than cold water and has higher saturation levels, some of the most concentrated brines are thermal waters. The mineral constituents that could be utilized and where they might be found, are considered. Particular attention is paid to the Salton Sea Geothermal Area and to the Permian Basin of southeastern New Mexico. The lack of detailed data combined with inadequate hydrometallurgical procedures are problems that will soon be overcome. (See also W72-01749) (Casey-Arizona)
W72-01754

SALINE WATERS: GENESIS AND RELATIONSHIP TO SEDIMENTS AND HOST ROCKS,

Texas Tech Univ., Lubbock. Dept. of Geosciences. J. R. Craig.

In: *Saline Water*, Mattox, R. B. (ed.), AAAS, Committee on Desert and Arid Zone Research, Contribution No 13, p 3-30, 1970. 7 fig, 6 tab, 64 ref.

Descriptors: *Saline water systems, *Aqueous solutions, *Evaporation, *Water chemistry, *Chemical properties, Sediments, Dissolved solids, Salts, Iron, Magnesium, Sodium, Potassium, Chlorides, Sulfates, Carbonates, Calcium, Silica, Bicarbonates, Connate water, Solubility, Geochemistry. Identifiers: Salt-sieving.

Saline waters are defined as any waters containing 3,000 or more ppm total dissolved solids. The dissolved solid content of natural waters may vary from 13 ppm (rainwater) to 336,000 ppm. The wide variety of geologic conditions in which waters are found combined with the range of different dissolved substances at varying concentrations makes classification of saline waters difficult. The two basic approaches to the classification problem are considered composition and genesis. Three gaseous and 9 solid substances commonly present in solution or suspension in natural waters are described in terms of their origins and solubility characteristics. The most common processes whereby saline waters are concentrated are: (1) supply from an initial source; (2) salt sieving; (3) sediment and rock solution; (4) evaporative concentration, which by far the most common method; (5) artificial contamination due to human activities. The process of evaporative concentration involves both marine and non-marine evaporation, and each is considered separately. Sea water is derived from rain water translated into runoff containing dissolved and suspended solids. The ionic processes of this together with those of subsurface water reactions and the formation of hypersaline waters and evaporite deposits are discussed and described with Janecke diagrams. (See also W72-01749) (Casey-Arizona)
W72-01755

TRANSFORMATIONS OF IRON BY BACTERIA IN WATER, New Jersey Agricultural Experiment Station, New Brunswick.

Robert L. Starkey.

In: *Biology of water pollution*, p 215-231. Compiled by W. M. Ingram, L. E. Keup, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967. 15 fig, 1 tab, 33 ref.

Descriptors: *Bacteria, *Iron bacteria, *Plant physiology, *Distribution systems, Water supply, Sulfur bacteria, Fouling, Water properties, Iron, Oxidation, Reduction (Chemical), Odor, Taste, Manganese, Water pollution control, Potable water, Pipes.

Identifiers: *Autotrophic bacteria, Ferric hydrate, Haplobacteria, Trichobacteria, Stalked bacteria.

Bacterial transformations of iron, its oxidation, reduction, dissolution, precipitation, and production or decomposition of iron organic compounds, are accomplished by specific iron bacteria, as well as by many non-specific and sulfur bacteria. Turbid water, fouling of pipes, and development of iron bog ores are some of the conspicuous manifestations of the activity of iron transformers. However, not all reactions of iron are well known because of the difficulties in obtaining pure cultures of their activators. Iron bacteria are physiologically similar to sulfur bacteria and are classified as autotrophic bacteria which are characterized by the following physiological properties: they can develop in a medium containing no organic material and require no externally supplied organic substances; their carbon requirements can be satisfied by dissolved carbon dioxide; and all required energy can be obtained from the oxidation of some specific incompletely oxidized inorganic substance. (See also W72-01786) (Wilde-Wisconsin)
W72-01811

CHEMISTRY OF NITROGEN AND PHOSPHORUS IN WATER.

American Water Works Association, New York. Water Quality Div. Committee on Nutrients in Water.

For primary bibliographic entry see Field 05C.
W72-01867

STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, For primary bibliographic entry see Field 05A. W72-01888

CHEMICAL COMPOSITION OF HIGHER WATER VEGETATION OF THE KIEV RESERVOIR (IN RUSSIAN),

Akademiya Nauk URSR, Kiev. Institut Hidrobiologii. Y. L. Korelyakova.

Gidrobiol Zb. 6 (5): 20-28. 1970. English summary.

Identifiers: Biomass, Carbohydrate, Chemical, Composition, Higher, Kiev, Macrophytes, Minerals, Protein, Reservoir, USSR, Vegetation.

The contents of ash, Ca, Mg, P, cellular tissue, sucrose, monosaccharides, total and protein N, and protein are presented for 15 spp. of higher water plants from the Kiev reservoir (*Phragmites communis*, *Butomus umbellatus*, *Glyceria aquatica*, *Typha angustifolia*, *Sparganium ramosum*, *Alisma plantago-aquatica*, *Polygonum amphibium*, *Nuphar luteum*, *Nymphaea alba*, *Elodea canadensis*, *Stratiotes aloides*, *Potamogeton perfoliatus*, *P. berchtoldii*, *P. lucens*, *Ceratophyllum demersum*). In the Kiev reservoir in 1967 36300 tons of organic matter was produced including: 9000 tons of wet protein, 15500 tons of cellular tissue and 1615 tons of the soluble carbohydrates. Copyright 1971, Biological Abstracts, Inc.
W72-01929

THE RADIOCHROMATOGRAPHIC ANALYSIS OF FRESH WATER RESOURCES, Florida Univ., Gainesville. Water Resources Research Center. S. P. Cram.

Available from National Technical Information Service as PB-204 865, \$3.00 in paper copy, \$0.95 in microfiche. Florida Water Resources Research Center, Gainesville, Publication No. 15 Oct 28, 1971. 49 p, 13 fig, 6 tab, 84 ref. OWRR A-012-FLA (3).

Descriptors: *Neutron activation analysis, *Gas chromatography, Trace elements, *Analytical techniques, *Metals, Sampling, *Chromium, Copper, Iron, Manganese, *Chelation.

Identifiers: Activation-chromatography coupling, Trace analysis, Beryllium, *Metal chelates, Gadolinium, Lutetium.

The study of radiochromatographic separations for the neutron activation analysis of trace level metals in fresh water sources is reported. Chromatographic separations of volatile metal-organic compound complexes were developed for post-irradiation separations. When the trace metals were complexed before irradiation, radiation degradation was found to be a function of the solution concentration, presence of excess reagent, irradiation time, and the neutron flux spectrum. Quantitative elution from the chromatographic column of the complexes of Cr, Mn, Fe, Be, Lu, Gd, and Cu were studied and found to yield recoveries between 52 per cent and 98 per cent. Two additional fluorinated types of organic complexing agents were found to give quantitative recovery of chromium after irradiation. Extensive studies are reported which describe the optimum conditions for separation and account for decomposition and adsorption losses in the system. The development of sampling systems, counting geometries, and sample transfer lines are reported which must be carefully considered when analyzing multicomponent metal chelate mixtures. (Morgan-Florida)
W72-01981

SOME ASPECTS OF THE GEOCHEMISTRY OF Fe, Fe and Mn in COASTAL WATERS AND IN FRESH-WATER SPRINGS ON THE SOUTHEAST COAST OF HAWAII,

Naval Research Lab., Washington, D.C.

P. E. Wilkins, T. B. Warner, and R. A. Carr.

Marine Geology, Vol 11, No 4, P M39-M46.

November 1971. 4 fig, 1 tab, 27 ref.

Descriptors: *Springs, *Water chemistry, *Hawaii, *Volcanoes, Leaching, Iron, Fluorides, Manganese, Trace elements, Sea water.

Identifiers: *Kilauea (Hawaii), Submarine volcanoes.

Fluoride, iron, and manganese were studied in coastal waters and fresh-water springs on the southeast coast of Hawaii. Samples were obtained in 1969 (quiet Kilauea) and in 1970 (moderate Kilauea eruption). Water samples taken near young submarine volcanoes on the submerged east rift zone of Kilauea and from fresh-water springs in the same area were not influenced by Kilauea activity. Leaching of fresh Kilauea pumice by fresh water and sea water at 25 deg C produced increases of fluoride, iron, and manganese in the water samples. The total amount removed by leaching decreased rapidly with time for fluoride and manganese; iron was removed more easily. With respect to these ions it appears that submarine volcanism will not affect nearby sea water very much in the periods between eruptions. The fresh-water springs in Hawaii show typical baseline values for the elements analyzed. There was no detectable influence of moderate eruption of Kilauea on these springs, or on rain and river water upwind of the eruption. The fluoride content of the underground water was close to 0.8 p.p.m., well within the optimum range commonly maintained artificially (0.8 to 1.0 p.p.m.) in potable water supplies elsewhere. (Knapp-USGS)
W72-01998

Field 02—WATER CYCLE

Group 2K—Chemical Processes

GEOCHEMICAL INTERPRETATIONS OF GROUNDWATER FLOW SYSTEMS,
Geological Survey, Washington, D.C.
W. Back, and B. B. Hanshaw.
Water Resources Bulletin, Vol 7, No 5, p 1008-1016, October 1971. 5 fig, 12 ref.

Descriptors: *Geochemistry, *Hydrogeology, *Reviews, Groundwater movement, Saline water intrusion, Path of pollutants, Drawdown, Water levels, Aquifer characteristics, Water quality, Water yield, Thermodynamics, Carbonate rocks.
Identifiers: Groundwater flow systems.

This brief review describes several of the chemical and isotopic techniques which are being applied to groundwater flow systems. Geochemical techniques used to facilitate the understanding of a groundwater system range from extremely simple to those requiring sophisticated theories, equipment, and procedures. An interpretation of the trilinear diagram for samples collected from the Yucatan Peninsula of Mexico provided evidence that the fresh-water body was only a few tens of meters thick and was underlain everywhere by an extensive body of salt water. A geochemical technique to identify the source of salt water in coastal aquifers is measurement of the carbon-14 concentrations. Carbon-14 may be used in carbonate aquifers to determine the velocity of groundwater movement, rates of chemical reactions, and distribution of hydraulic conductivity. The principles of irreversible thermodynamics applied to groundwater systems provide a basis for prediction of changes in head distribution and chemical character of the water resulting from imposed stresses on the system. Proper application of irreversible thermodynamics combines potential theory with principles of reversible chemical thermodynamics to explain chemical reactions and processes of groundwater systems. (Knapp-USGS) W72-02007

CHEMICAL INTEGRATING THERMOMETER FOR WATER TEMPERATURE MEASUREMENT,
Environmental Data Service, Silver Spring, Md.
Lab. for Environmental Data Research.
F. A. Godshall.
Environmental Data Service, Department of Commerce Publication, p 9-10, October 1971. 1 fig, 4 ref.

Descriptors: *Thermometers, *Water temperature, *Instrumentation, *Test procedures, Chemicals, Opacity, On-site investigations, Bays, Research equipment, Costs.
Identifiers: *Chemical integrating thermometer.

The chemical integrating thermometer is potentially an ideal measuring device of mean water temperature. It is very inexpensive (about 30 cents), needs no servicing or maintenance, provides an integrated record without a recording device, and is very accurate. The chemical thermometer obtains an integrated mean temperature through the measured hydrolysis of sucrose into glucose and fructose. The reaction velocity is proportional to the hydrogen ion concentration (pH) and temperature of the sucrose solution. Tests in the Chesapeake Bay were conducted by fastening the chemical thermometer of monofilament fishing line. This was tied to an anchoring device so that the thermometer could be retrieved after approximately 30 days of exposure. At retrieval, the thermometers were frozen in dry ice for transport back to the laboratory. There, the thermometer solution was defrosted and poured into the sample tube of the polarimeter for measurement of the optical rotation. The change in optical rotation of the sucrose from the original measurement is proportional to a change in the concentration caused by the temperature. The chemical thermometer might be deployed from buoys, lightships, towers, and other fixed platforms in order to gather data useful in hydroclimatology, the study of the ocean's long-term characteristics. (Woodard-USGS) W72-02013

WATER EXCHANGE AT THE MOUTH OF THE GULF OF CALIFORNIA,
Florida State Univ., Tallahassee. Dept. of Oceanography.

For primary bibliographic entry see Field 02E.
W72-02041

TEMPERATURE AND CONDUCTIVITY MEASUREMENTS UNDER ICE ISLAND T-3,
Oregon State Univ., Corvallis. Dept. of Oceanography.

S. Neshyba, V. T. Neal, and W. Denner.
Journal of Geophysical Research, Vol 76, No 33, p 8107-8120, November 20, 1971. 9 fig, 1 tab, 23 ref.

Descriptors: *Stratification, *Density stratification, *Arctic Ocean, *Thermal stratification, Diffusion, Profiles, Bathymetry, Bathythermographs, Water temperature, Salinity.
Identifiers: Ice Island T-3.

Marked step-like structure exists in vertical profiles of temperature and salinity in the Arctic Ocean. This structure occurs between 200 and 500 meters depth, where both temperature and salinity increase with depth. The structure consists of thin sheets (0.1 meter thick) separating adjacent homogeneous layers (3 meters thick) that differ in temperature by 0.02 degrees C and in salinity by 0.001. While the step structure is quite persistent, its character varies markedly with depth. Intermediate layers were observed, as well as noncoincident temperature and salinity gradient sheets. This type of layering probably arises from the double-diffusive process. (Knapp-USGS) W72-02042

THE ORIGIN OF METAL-BEARING SUBMARINE HYDROTHERMAL SOLUTIONS,
Oregon State Univ., Corvallis. Dept. of Oceanography.

J. B. Corliss.
Journal of Geophysical Research, Vol 76, No 33, p 8128-8138, November 20, 1971. 3 fig, 2 tab, 46 ref.

Descriptors: *Volcanoes, *Atlantic Ocean, *Pacific Ocean, *Water chemistry, *Trace elements, Chemical precipitation, Magmatic water, Solutes, Leaching, Aqueous solutions.
Identifiers: Submarine hydrothermal solutions.

Instrumental activation analyses were made of 16 major and trace elements in a suite of mid-Atlantic ridge basalts. The slowly cooled interior portions of these submarine extrusions are depicted, relative to the quenched flow margins, in several elements that are enriched in pelagic sediments and manganese nodules (Mn, Fe, Co, the rare earth elements, and others). Many of these elements are excluded from the solid phases that crystallize from the melt, and thus are concentrated in residual liquids. Additional elements are mobilized during the deuteric alteration of early-formed olivine and the formation of immiscible sulfide liquids. These components occupy intergranular boundaries in the hot solid rock mass, and are dissolved as chloride complexes in sea water introduced along contraction cracks. These solutions may be the metal-bearing 'hydrothermal exhalations' or 'volcanic emanations' that accompany submarine volcanism, which are often cited as a source of metals into the pelagic environment. A significant fraction of the mass of these elements that reside in pelagic sediments could have been supplied by this process. Amorphous iron-manganese-silica material from the east Pacific rise may form by direct precipitation from these hydrothermal solutions following their introduction into sea water. (Knapp-USGS) W72-02044

GAS-PHASE CATALYTIC OXIDATION OF PHENOL IN DILUTE CONCENTRATIONS WITH WATER VAPOR,
Delaware Univ., Newark. Dept. of Chemical Engineering.

For primary bibliographic entry see Field 05D.
W72-02050

CONCENTRATION GRADIENTS IN AQUIFERS,
Tulsa Univ., Okla.

For primary bibliographic entry see Field 02F.
W72-02055

IODINE AND ALGAE IN SEDIMENTARY ROCKS ASSOCIATED WITH IODINE-RICH BRINES,

Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.
A. G. Collins, J. H. Bennett, and O. K. Manuel.
Geological Society of America Bulletin, Vol 82, No 9, p 2607-2610, September 1971. 2 fig, 2 tab, 7 ref.
NSF Grant GA-12099.

Descriptors: *Sedimentary rocks, *Brines, *Algae, *Oklahoma, *Iodine radioisotopes, Uranium radioisotopes, Analytical techniques, Paleozoic era, Water chemistry.
Identifiers: Neutron activation analysis.

Neutron activation analyses of iodine and uranium in Paleozoic sedimentary rocks from the northern Oklahoma platform of the Anadarko basin showed 0.9 to 12.3 ppm I and 0.07 to 8.7 ppm U. The samples were taken from strata in Kingfisher County, Oklahoma, where anomalously high concentrations of iodine were found in associated subsurface brines. Micropaleontological examinations revealed algal strands in the more iodine-rich rocks. (Woodard-USGS) W72-02073

SALINITY OF SURFACE WATER IN THE LOWER COLORADO RIVER - SALTON SEA AREA,

Geological Survey, Washington, D.C.
B. Irelan.
Available from Sup Doc GPO, Washington, D C 20402 - 50 cents. Geological Survey Professional Paper 486-E, 1971. 40 p, 12 fig, 19 tab, 9 ref.

Descriptors: *Salinity, *Surface waters, *Colorado River basin, *Hoover Dam, *Water quality, Chemical analysis, Reviews, Dissolved solids, Lakes, Reservoirs, Streams, Streamflow, Flow measurement, Stream gages, Hydrologic data, Water resources development.
Identifiers: *Lower Colorado River (Salton Sea area).

Records of salinity and computations of the mineral burden of the Colorado River and tributary surface inflow from Lees Ferry to the Mexican border and of streams in the adjacent Salton Sea basin are summarized. The Colorado River at Grand Canyon has a 40-year weighted-average concentration of about 600 mg/liter. Since Lake Mead was formed, dissolved-solids concentrations in Colorado River water between Hoover and Imperial Dams have generally ranged between 600 and 900 mg/liter, with calcium sulfate always the dominant dissolved salt. Dissolved-solids concentrations are now relatively constant at Imperial Dam because of upstream storage, but both the flow and the mineral burden of the Colorado River below the dam are greatly reduced by diversions to the All-American and Gila Gravity Canals. Colorado River water flows through the All-American Canal from Imperial Dam to Imperial and Coachella Valleys in the Salton Sea basin without material change in salinity. (Woodard-USGS) W72-02074

PLUTONIUM-239 IN AND OVER THE ATLANTIC OCEAN,
Woods Hole Oceanographic Institution, Mass.

For primary bibliographic entry see Field 05B.
W72-02083

CESIUM-137 IN THE NORTH ATLANTIC MEASURED BY SELECTIVE ABSORPTION IN SITU, Rhode Island Univ., Kingston. Narragansett Marine Lab.

For primary bibliographic entry see Field 05B.

W72-02084

NITROGEN BALANCE FOR A 23 SQUARE MILE MINNESOTA WATERSHED, Arizona Univ., Tucson. Office of Arid Lands Studies.

J. D. Johnson.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 53-84, 1971. 8 tab, 33 ref.

Descriptors: *Nitrogen cycle, *Watersheds, *Minnesota, *Soil environment, *Atmosphere, Ammonium compounds, Nitrogen fixation, Nitrogen compounds, Nitrates, Nitrites, Groundwater, Surface waters, Water chemistry, Arid lands, Denitrification, Precipitation (Atmospheric), Subsurface drainage, Fertilizers, On-site data collections.

The Nitrogen balance of a watershed near the city of New Prague, Minnesota was evaluated as part of an overall study on lake and stream eutrophication. Although the N-balance of a humid midwest watershed cannot be expected to be identical to that of an arid watershed, the processes are the same and differences should be mainly quantitative. Sources of input and causes of depletion are reviewed for 4 points in the Nitrogen cycle: the atmospheric zone, the soil-atmosphere interface, the plant-root and soil-water zone and the surface water zone. In the New Prague watershed, commercial fertilizer and bulk precipitation were the major sources of input, contributing, respectively, 53% and 34.4% of the total input of 2.34 million lb/yr. Crop yield and soil or groundwater storage contributed 52.1% and 20.4% of non-enrichment depletions. The closeness of the values of crop yield and commercial fertilizer application was an unfortunate coincidence and is certainly not an indication that the entire fertilizer supply was taken up by crops. In an arid environment, free from fertilized agriculture, bulk precipitation probably provides the major source of Nitrogen compounds. (See also W72-02212) (Casey-Arizona)

W72-02216

2L. Estuaries

CHANNEL STABILITY IN THE ESTUARY: CONTROLS BY BEDROCK AND UNCONSOLIDATED POST-GLACIAL SEDIMENT, Dundee Univ., Newport-on-Tay (Scotland). Tay Estuary Research Center.

A. T. Buller, and J. McManus.

Engineering Geology, Vol 5, No 3, p 227-237, October 1971. 9 fig, 4 ref.

Descriptors: *Estuaries, *Stream erosion, *Channel morphology, *Dredging, *Bank stability, Alluvial channels, Hydraulic models, Channel improvement, Channel erosion.

Identifiers: Tay Estuary (Scotland).

Borehole and geophysical data were collated for two sections across the Tay estuary at Dundee, Scotland. A complex late-glacial and Holocene fill rests on a basement of Devonian sandstones and lavas. Comparative analysis of bathymetric charts (1816-1970) enable areas of present-day relatively stable and unstable bed to be identified. Stable areas are underlain by either gravels or partially compacted clays; unstable areas by loose, coarse to fine, sands. Non-migratory channels coincide with the stable areas; shifting sand banks and migratory channels occur elsewhere. Channel wandering can only take place in areas where current strengths are competent to erode easily and to transport bed materials. Where the substrate consists of less easi-

ly erodible bed materials, the channel migration is restricted. Artificial dredging of new channels into stable substrates may produce stable, self-maintaining waterways. Dredging in unstable areas is often a short-term, uneconomic expedient. The use of hydraulic models to determine modifications to channels frequently entails mobile bed techniques, commonly using uniform beds of effectively infinite depth. Unless the substrates within and beneath the mobile bed are reproduced, the true "natural" behavior of channels and banks cannot be accurately assessed. (Knapp-USGS)

W72-01721

DISCONTINUITIES IN STRATIFIED FLOWS, Waterloopkundig Laboratorium, Delft (Netherlands).

For primary bibliographic entry see Field 02E.

W72-01723

TIDAL CHOKING,

Utah Univ., Salt Lake City. Dept. of Civil Engineering.

B. Glenne, C. R. Goodwin, and C. F. Glanzman. Journal of Hydraulic Research, Vol 9, No 3, p 321-333, 1971. 7 fig, 16 ref.

Descriptors: *Tidal effects, *Estuaries, *Tides, *Water level fluctuations, *Darcy-Weisbach equation, Streamflow, Waves (Water), Discharge (Water), Roughness (Hydraulic), Unsteady flow.

Water level changes are analyzed in a basin connected to the ocean by a constricted inlet. The ocean hydraulic function is a semi-diurnal sinusoidal tide, and the inlet damping function is Darcy-Weisbach's friction equation. The channel flow is assumed to be stored in the inside basin. A digital computer may be used to solve incrementally a finite-difference form of the basic non-linear differential equation. General graphical solutions are presented. (Knapp-USGS)

W72-01725

OXYGEN REQUIREMENTS OF SOME MARINE AND ANADROMOUS FISHES, WITH PARTICULAR REFERENCE TO PROBLEMS OF MEASUREMENT, Southeastern Massachusetts Technological Univ., North Dartmouth.

For primary bibliographic entry see Field 05C.

W72-01875

THE PREVENTION OF POLLUTION IN ESTUARIES,

For primary bibliographic entry see Field 05G.

W72-01883

ON THE NANNOPLANKTON OF THE TAMUR ESTUARY (PLYMOUTH, GREAT BRITAIN), Jean-Paul Mommants.

Bull Soc Roy Bot Belg. 104 (1): 173-180. Illus. 1971. (Engl. summ.).

Identifiers: Britain, Chlorophyll, Estuary, Great, Nanno, Plankton, Plymouth, Salinity, Tamar.

The Tamar estuary was sampled from sea to freshwater. Salinity and chlorophyll a were measured and nanoplankton determined. Some nanoflagellates were cultured and their salinity range tested. Copyright 1971, Biological Abstracts, Inc.

W72-01918

DYNAMICS OF CHANGES IN CHEMICAL COMPOSITION OF GREEN ALGAE OF THE BLACK SEA, (IN RUSSIAN), V. N. Chekoi, M. S. Dudkin, and I. V. Areshidze.

Izv Akad Nauk Mold SSR Ser Biol Khim Nauk. 1.

76-79, 1970.

Identifiers: Algae, Black, Chemical, Cladophora-Vagabunda, Composition, Dynamics, Enteromorpha-Linza, Green, Mono, Poly-Saccharides, Sea, Ulva-Lactuca, USSR.

In summer months, a large amount of easy and difficult to hydrolyze polysaccharides is formed in green algae. The quantitative composition of monosaccharides of green algae (Enteromorpha linza, Ulva lactuca, Cladophora vagabunda) growing in the Black Sea and its estuaries does not depend on the vegetation period. The quantitative ratio of residues of monosaccharides in polysaccharides of green algae depends on the species of green algae as well as their vegetation periods. Copyright 1971, Biological Abstracts, Inc.

W72-01920

BOTTOM DIATOMS IN THE MIHO BAY AND ITS NEIGHBORING AREA ON SOUTHWESTERN PART OF THE JAPAN SEA, ICHIYASUO NOGUCHI.

Industrial Science and Technology Agency, Kawasaki (Japan) Geological Survey.

Bull Geol Surv Jap. 21 (4): 259-266. Illus. Maps. 1970. In Jap. with Engl. summ.

Identifiers: Bay, Bottom, Brackish, Coscinodiscus, Diatoms, Fresh, Japan, Melosira-Sulcata, Miho, Neighboring, Salt, Sea, Southwestern, Thalassiothrix.

Fifteen bottom samples from the bay, and 17 bottom samples and 4 gravity core samples from the vicinity of the Oki Islands were taken. The bottom materials are medium or coarse sand in the bay and inner shelf, and mud in the open sea. Many Centrales are present in the sediments of the shelf area. Subtropical species are found in the sediments of the shelf area. Cold-water were mixed off-shore or in open sea bottom at about 1000 m in depth. Many fresh or brackish water species were found in the coastal sediments. Inner bay type diatoms are found between the bay mouth of Miho and the bottom of the sea about 100 m in depth. Oceanic plankton was not found widely, but open sea or bay plankton was characterized by the abundance of Coscinodiscus, and Thalassiothrix. Bay or coastal benthonic diatoms were characterized by lower amounts of Melosira sulcata. Copyright 1971, Biological Abstracts, Inc.

W72-01927

DIURNAL VARIATIONS IN THE CHEMICAL CHARACTERISTICS OF THE OGEECHEE ESTUARY IN GEORGIA, Skidaway Inst. of Oceanography, Savannah, Ga.

Herbert L. Windom, and Kevin C. Beck.

Bull Ga Acad Sci. 29 (1): 65-75. Illus. Map. 1971.

Identifiers: Chemical, Dissolved, Diurnal, Estuary, Georgia, Minerals, Ogeechee, Organisms, Oxygen, pH, Variations.

The diurnal variations in dissolved O₂ and pH in the Ogeechee estuary reflect their control by metabolic processes of estuarine organisms. This is a common feature of estuaries in other areas as well. These variations are more pronounced in the middle of the estuarine zone in waters having intermediate salinities. Mg, Na and chloride vary in the estuary in relation to tidal conditions. Ratios of the elements, however, change, going from fresh water to a constant value in saline waters. These ratios serve as a sensitive indicator of the fresh water-saline water boundary. Post-collection changes in the concentration of Fe in estuarine water samples suggest that particulate and dissolved Fe are able to reequilibrate with changes in environmental conditions in diute areas of the Ogeechee estuary. In more saline areas the dissolved Fe appears to be buffered against rapid post-collection changes due to the absence of particulate Fe (OH)₃. Copyright 1971, Biological Abstracts, Inc.

W72-01934

TROPHIC CHAINS OBSERVED IN THE BAY OF PORT PARADISE (PALMER PENINSULA, ANTARCTICA) IN RELATION TO THE VARIATIONS OF THE FERTILITY OF ITS WATERS, (IN SPANISH), Instituto Antartico Argentino, Buenos Aires.

Aldo P. Tomo.

Field 02—WATER CYCLE

Group 2L—Estuaries

Contrib Inst Antartico Argent. 131, 3-14. Illus. 1970. (English summary).
Identifiers: Antarctica, Bay, Chains, Fertility, Palmer, Paradise, Peninsula, Port, Relation, Trophic, Variations.

The annual variation of the physico-chemical, hydrological and meteorological constants that influence the actual fertility of the sea, which in turn affect trophic chains, is considered. Copyright 1971, Biological Abstracts, Inc.
W72-01935

THE DISTRIBUTION AND ABUNDANCE OF SAND GOBIES, GOBIUS MINUTUS, IN THE YTHAN ESTUARY,
Fisheries Research Board of Canada, Winnipeg (Manitoba). Freshwater Inst.

M. C. Healey.
J Zool (London). 163 (2): 177-229. Illus. 1971.
Identifiers: Abundance, Breeding, Distribution, Estuary, Gobies, Gobius-Minutus, Loss, Sand, Scotland, Sea, Winter, Ythan.

The aims of this study were, first, to describe the distribution and abundance of *G. minutus* in the Ythan estuary and, when it became apparent that there were striking seasonal changes in the abundance of gobies, to attempt to explain these changes. Gobies were abundant in the estuary from July until Jan. or Feb. each year, and scarce for the rest of the year. The sharp drop in goby numbers in the estuary in Jan. or Feb. each year was associated with a change in the sex ratio from 50% females to 80% females, and a change in dispersion from aggregated to random, and a restriction of the gobies' range to the lower half of the estuary. It seemed that these associated changes should all be the result of a common cause. The disappearance of gobies in Jan. or Feb. was not a result of low water temperatures in the estuary in winter, nor was it the result of changes in water salinity. Measurements of food intake and available food supplies suggested that there was no shortage of food at this time. The disappearance was, however, associated with gonad maturation, suggesting that the loss of fish had something to do with the breeding requirements of the goby. It is hypothesized that the loss of gobies in winter was the result of their migrating to sea to breed because their eggs would not develop in the estuary. This hypothesis was tested by attempting to capture gobies at sea, by measuring their salinity preference, and by attempting to rear their eggs at various salinities. It was not possible to capture more than a few gobies outside the estuary. Ripe fish did not show any preference for high salinity water, and their eggs were intolerant of high salinities. It seemed, therefore, that the hypothesis of an emigration to sea to breed was incorrect, and that something else must explain the losses of gobies in winter, possibly heavy predation. Copyright 1971, Biological Abstracts, Inc.
W72-01954

MEASUREMENT OF A THREE-DIMENSIONAL FIELD OF WATER VELOCITIES AT A DEPTH OF ONE METER IN AN ESTUARY,
Johns Hopkins Univ., Baltimore, Md. Dept. of Earth and Planetary Sciences.

R. C. Seitz.
Journal of Marine Research, Vol 29, No 2, p 140-150, May 15, 1971. 9 fig, 4 ref. ONR Contract No 4010 (11).

Identifiers: *Estuaries, *Waves (Water), *Turbulence, Fourier analysis, Streamflow, Ocean waves, Winds, Instrumentation.

The direct measurement of the three components of velocity at 1m below the surface in the Patuxent Estuary yielded energy spectra that could be separated into the background turbulent energy and a surface-wave induced field of velocities. Comparison of the Fourier transforms of longitudinal and vertical components with Fourier transforms of a computed record of depth-attenuated surface-wave velocities show a very close agree-

ment. In naturally occurring turbulent regimes, the velocity field at depths that are subject to wave action may be described as a sum of the turbulent velocity field of motion and the surface-wave induced field of motion. (Knapp-USGS)
W72-02015

OSO CREEK TECHNICAL ASSISTANCE STUDY: PRELIMINARY STUDY ON THE PROBLEMS AND OPPORTUNITIES FOR DEVELOPMENT OF OSO CREEK AND OSO BAY.

Coastal Bend Regional Planning Commission, Corpus Christi, Tex.
For primary bibliographic entry see Field 06B.
W72-02028

SOME EXACT SOLUTIONS TO THE EQUATIONS DESCRIBING AN IDEAL-FLUID THERMOCLINE,
Goteborg Univ. (Sweden). Inst. of Oceanography.
For primary bibliographic entry see Field 02G.
W72-02032

OBSERVATIONS ON SHORT-PERIOD INTERNAL WAVES IN MASSACHUSETTS BAY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
D. Halpern.

Journal of Marine Research, Vol 29, No 2, p 116-132, May 15, 1971. 13 fig, 1 tab, 17 ref. ONR Contract Nonr 1841 (74).

Identifiers: *Thermocline, *Waves (Water), *Seiches, *Bays, *Massachusetts, Ocean waves, Tides, Currents (Water), Thermal stratification, Density stratification, Stratified flow, Water circulation.

Identifiers: Massachusetts Bay.

Nine km west of a prominent sill in Massachusetts Bay, the seasonal thermocline heaves up and down in phase with periods of 6 to 8 minutes for about 2.5 hours during flood tide. A sudden rise in the general temperature level accompanies the onset of the short-period motion. The maximum vertical displacement occurs at 20 m below the surface. The distribution of the displacements agrees within 10% with the eigenfunction of the first mode of internal gravity waves; the eigenfunction was computed from measurements of density and velocity. Long-crested, short-wavelength, narrow surface bands parallel to the sill were measured concurrently with the high-frequency temperature oscillations. The high-frequency fluctuations seem to be internal waves of mode one, propagating in the same direction with respect to the moving medium. (Knapp-USGS)
W72-02035

A BIAXIAL PROPELLER CURRENT-METER SYSTEM FOR FIXED-MOUNT APPLICATIONS,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.

For primary bibliographic entry see Field 07B.

W72-02038

HYDROLOGIC COMPUTATIONAL METHODS FOR MARINE HYDRAULIC ENGINEERING CONSTRUCTION (METODY MORSKIKH GIDROLOGICHESKIH RASCHETOV Dlya STROITEL'STVA),
State Oceanographic Inst., Moscow (USSR).
A. A. Yushchak, and B. Kh. Glukhovskiy.
Meteorologiya i Gidrologiya, No 6, p 19-26, June 1971.

Identifiers: *USSR, Sea swells.

Theoretical and experimental investigations were conducted by the State Institute of Oceanography to develop hydrologic computational methods to meet the demands of marine hydraulic engineering construction. A handbook prepared in 1970 entitled 'Guide to the Calculation of Elements of the Hydrologic Regime in the Coastal Zone of Seas and in River Estuaries' is the product of this research and incorporates the results of studies by the State Institute of Oceanography and other scientific establishments. The Guide sets forth methods for calculating the following hydrologic elements: water level, sea swell, ice, currents, water temperature, and, for river estuaries, the water and sediment discharge in delta arms. Methods are given for calculating a number of hydrochemical parameters describing the solvent-action properties of sea water. (Josefson-USGS)
W72-02094

A CLASS OF PROBABILITY MODELS FOR LITTORAL DRIFT,
Army Coastal Engineering Research Center, Washington, D.C.
For primary bibliographic entry see Field 06A.
W72-02121

COASTAL ZONE MANAGEMENT--THE TIDE-LANDS: LEGISLATIVE APATHY VS. JUDICIAL CONCERN,
For primary bibliographic entry see Field 06E.
W72-02153

OBSERVATIONS ON THE SUMMER POPULATION OF PHYTOPLANKTON IN MATOYA BAY, SHIMA PENINSULA, 1953 AND 1954 (IN JAPANESE),
Hokkaido Univ. (Japan). Faculty of Fishery. Teruyoshi Kawamura, Kikuo Fukushima, and Kohei Karohji.
Bull Far Fish Hokkaido Univ. 21 (2): 113-122. Illus. Maps. 1970. English summary.
Identifiers: Bay, Diatoms, Growth, Japan, Matoya Peninsula, Phyto, Plankton, Population, Shima, Succession, Summer.

In the summer of 1953, the composition of phytoplankton population in various parts of the bay was observed and in the summer of 1954, the succession of phytoplankton population from July till Sept. was studied. In addition, brief experiments on the growth of diatoms in different kinds of water were made. Copyright 1971, Biological Abstracts, Inc.
W72-02200

THE ECOLOGY OF SOUTH AFRICAN ESTUARIES: X. ST. LUCIA: A SECOND REPORT,
Cape Town Univ. (South Africa). Dept. of Zoology.
N. A. H. Millard, and G. J. Broekhuysen.
Zool Afr. 5 (2): 277-307. Illus. Maps. 1970.

Identifiers: African, Animal, Checklist, Ecology, Estuaries, Nd, Plant, South, St-Lucia.

The aquatic ecology of the St. Lucia system is described for the period June 1964, to Jan. 1965. The fauna of various types of habitat is described, and the fauna as a whole discussed in relation to salinity and other factors. A complete checklist of the animals and common plants is appended, in which the species are assigned to components. The conditions are compared with those from an earlier survey in 1948 to 1951, and a brief comparison is made with Knysna Estuary in which conditions are known to be more stable. Copyright 1971, Biological Abstracts, Inc.
W72-02204

MEASUREMENTS OF PRIMARY PRODUCTION DARK FIXATION AND VERTICAL DISTRIBUTION OF THE MICROBENTHIC ALGAE IN THE ORESUND,
Copenhagen Univ., Hillerod (Denmark). Freshwater-biological Lab. Eivind Gargas.

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Saline Water Conversion—Group 3A

Ophelia. 8 (1): 231-253. Illus. 1970.

Identifiers: Algae, Benthic, Carbon-14, Dark, Denmark, Diatoms, Distribution, Fixation, Measurements, Micro, Oresund, Primary, Production, Ruppia-M, Vertical.

Estimations of primary production of the microbenthic algae have been carried out in Oresund in shallow water off Niva and in deeper water off Helsingør, using a ^{14}C technique. At Niva the highest actual production occurred in May in the Ruppia-flat; in the following months it was highest just off the beach. The Ruppia is assumed to have a beneficial influence on the primary production in early summer since its roots bind the sand and this produces a sheltered habitat. Later in the year the opposite will be the case as the growing Ruppia will shut out some of the light and cause a competition for nutrient salts. At Niva the vertical distribution of diatoms is fairly even down to 4 cm depth while off Helsingør at a depth of 8 m the entire standing crop is found between 0 and 2 mm. At the end of the year the algae concentrate in the uppermost 2 mm. This concentration is strong for the pseudobenthic algae and commences for these algae about a week before a corresponding concentration of the psammophytic algae. This could be explained in terms of reduced grazing effect and migration of the algae. In Niva the percentual dark fixation increases from the beach and seawards. It was highest for the psammophytic algae. It increased with increasing depth in the sediment. Strong fluctuations in the dark fixation from 4-5 cm depth may be explained by displacements of a redox-discontinuity layer at this depth.—Copyright 1971, Biological Abstracts, Inc.

W72-02205

PROBLEMS OF INDUSTRIAL RESIDUAL WATERS IN THE HOOGHLY ESTUARY ZONE (INDIA), CONCRETELY THE ONES FROM PAPER PULP AND HYDROGENATED VEGETABLE OIL INDUSTRIES (PROBLEMES D'EAU RESIDUAIRES INDUSTRIELLES DANS LA ZONE DU HOOGHLY ESTUARY (INDE), NOTAMENT DES FABRIQUES DE PATE A PAPIER ET D'HUILE VEGETALE HYDROGENEE),

Institut Central de Recherches sur les Peches Interieures, Barrackpore (India).

For primary bibliographic entry see Field 05B.

W72-02208

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

NEW WATER THROUGH DESALTING,

Office of Saline Water, Roswell, N. Mex. Roswell Test Facility.

C. Grua.

In: Saline Water, Mattox, R. B. (ed.), AAAS, Committee on Desert and Arid Zones Research, Contribution No. 13, p. 98-105. 1970.

Identifiers: *Brine disposal, *Desalination plants, *Desalination processes, *Brackish water, *Federal project policy, Water supply, Fresh water, Distillation, Reverse osmosis, Planning, Research and development, Economic feasibility.

Water that is not consumptively used by man is polluted by man. As part of a national commitment to upgrade water quality standards, new, economically feasible supplies of fresh water must be found. The Office of Saline Water is dedicated to this task, and its research and development efforts in the area of desalination are reviewed. In 1951, only a trickle of water was produced at a cost of 4.00 dollars per 1,000 gallons. By 1975, production should reach 1 billion gallons per day, and in a Tijuana, Mexico plant, soon to be in production, costs will be 65-70 cents per 1,000 gallons. The problem of brine disposal has been receiving much attention

because the current methods, evaporation ponds and deep well injection, are inadequate. About 1/2 of the U.S. overlays aquifers containing water of 1000-3000 ppm, so brackish water conversion may be as important as marine water desalination. Various test facilities and their various desalination technologies are described. The most promising methods are reverse osmosis and distillation. All considerations indicate that desalination will continue to increase in importance as a source of fresh water supplies in the U.S. (See also W72-01750 thru W72-01755) (casey-Arizona)

W72-01749

A SURVEY OF SALINE GROUND WATER AS A MINERAL RESOURCE,

New Mexico Bureau of Mines and Mineral Resources; and New Mexico Inst. of Mining and Technology, Socorro.

For primary bibliographic entry see Field 02K.

W72-01754

REVERSE OSMOSIS PILOT PLANT FOR DESALINATION OF SEA WATER,

Universal Water Corp., Del Mar, Calif.

Serop Manjikian.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402 Price \$0.45. Office of Saline Water Research and Development, July 1969, Report No 448, 36 p, 12 fig. OSW Contract 14-01-0001-1451.

Identifiers: *Reverse osmosis, *Cellulose, Desalination plants, Membranes, *Desalination processes, Sea water, Pilot plants.

Identifiers: Cellulose acetate, Formamide, Pyridine, Acetone.

A 2,500-gpd two-stage sea water reverse osmosis unit is described based on a tubular configuration which employs a cellulose acetate type membrane of the formamide formulation modified with pyridine. The purpose of the work was to prepare a two-stage test unit for subsequent field operation on sea water. The report describes the unit construction, gives the membrane formulation and supplies data on an initial laboratory test prior to field testing. Design criteria for the unit call for operation of the 1st stage at 1000-1200 psi and the second stage at 650 psi with product water of 3000-5000 ppm in the 1st stage and 500 ppm in the second stage. The report reflects prior work supported by the U.S. Navy (Port Hueneme) and the continuing OSW-U.S. Navy field testing of the unit at the U.S. Navy Civil Engineering Laboratory at Port Hueneme. (See also W71-10662) (OSW abstract)

W72-01831

CONTINUOUS WASHING OF BRINE FROM ICE,

Massachusetts Inst. of Tech., Cambridge.

Thomas K. Sherwood, P. L. Thibaut Brian, Adel F. Sarofim, and Kenneth A. Smith.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402 Price \$0.45. Office of Saline Water Research and Development Progress Report No. 436, May 1969. 36 p, 10 fig, 20 ref. OSW Grant No. 14-01-0001-1719.

Identifiers: *Desalination processes, *Freezing, *Ice, *Separation techniques, *Dispersion, *Brines. *Wash column.

A pilot-scale wash column was operated experimentally for the purpose of obtaining data on wall friction and on brine dispersion. In both cases, it was possible to obtain good correlation between the data and simple physical models. The correlation for wall shear stress required a model for the transmission of force by particle-to-particle contact within the bed. The study focuses on the brine dispersion process which occurs in the washing section (above the brine draw-off), and upon the frictional force which occurs in the washing section

(above the brine draw-off), and upon the frictional force which is generated by the motion of the ice plug past the side walls. The first of these is important because it dictates product salinity, and the second is an important consideration in column design and operability. All of the data were obtained under flooded conditions, i.e., all voids in the washing section were liquid-filled. In addition to ice washing, on-going investigations on ice nuclei formation, and on melting of porous ice beds are reviewed very briefly. (OSW abstract)

W72-01832

IMPROVED MEMBRANES FOR REVERSE OSMOSIS,

Research Triangle Inst., Research Triangle Park, N.C.

H. Yasunda, and C. E. Lamaze.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402 Price \$1.00. Office of Saline Water Research and Development Progress Report No. 473, September 1969. 93 p, 27 fig, 15 tab, 40 ref. Grant No. 14-01-0001-1452.

Identifiers: *Reverse osmosis, *Membranes, Desalination, *Diffusivity, *Permeability, *Cellulose.

Identifiers: *Membrane coefficients, *Membrane transport, *Polymer membranes, *Water flux, Cellulose acetate.

Water and salt permeate through a skinned reverse osmosis membrane has been hypothesized to occur by means of an activated diffusion mechanism. The low salt permeabilities and, therefore, high salt rejections have also been attributed to the low salt solubilities in the polymer matrix. The high water fluxes, in turn, have been attributed to the hydrophilic character of the polymer molecules used in the fabrication of the reverse osmosis membrane. Based on these considerations, studies were carried out to investigate the fundamental parameters governing high salt rejection and high water flux, using model homogeneous membranes of varying hydrophilic - hydrophobic content. (OSW abstract)

W72-01833

CONSTANT TOTAL PRESSURE EVAPORATION PROCESS WITH HEAT REUSE BY A BUILT-IN ENGINE,

Denver Research Inst., Colo.

Chen-yen Cheng, Hung-yeen Sung, and Kyung Chang Kwon.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402 Price \$0.75. Office of Saline Water Research and Development Progress Report No. 703, September 1971. 86 p, 2 tab, 50 fig, 8 ref. OSW Contract No. 14-01-0001-2144.

Identifiers: *Desalination processes, *Distillation, *Evaporation, Heat transfer, Mass transfer, Evaporators, Thermodynamic behavior, Boiling. Identifiers: Heat reuse, Fluoroalcohol (C-3, C-5), Fluorocarbon (FC-75).

In a conventional evaporator, the pressure at the condensing side is maintained considerably higher than that at the boiling side in order to obtain the temperature differential required for heat transfer. In the subject process, a suitably selected auxiliary system consisting of two organic substances is incorporated within an evaporating system so that the heat released in the condensation step can be utilized in supplying the heat needed in the evaporating step under a constant total pressure condition. One of the two organic substances is called a boiling point depressor and is added to the boiling mass of the evaporator to lower its boiling temperature. The other organic substance is called an absorbent and is added on the condensing side to absorb the boiling point depressor vapor and raise the temperature of the condensing mass. With the help of the auxiliary system, it is possible for the temperature of the condensing mass to become

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

higher than that of the boiling mass even at the same pressure and the desired heat reuse can be accomplished. Suitable candidate materials for carrying out the subject process have been identified and characterized. A preliminary study has been made of the heat transfer and mass transfer problems and some unexpected problems which require consideration in the design of an evaporator system have been identified. (OSW abstract)

W72-01834

STABILIZATION OF PRODUCT WATER FROM SEAWATER DISTILLATION PLANTS, Oak Ridge National Lab., Tenn.

C. D. Bopp, and S. A. Reed.

For sale by Supt. of Documents U.S. Government Printing Office, Washington, D.C. 20402, \$0.50. Office of Saline Water Research and Development Progress Report No. 709, July 1971, 44 p, 2 fig, 5 tab, 84 ref. Agreement 14-30-2535, W.O. 23.

Descriptors: *Distillation, *Potable water, *Corrosion control, *Desalination, Inhibitors, Pipes, Desalination apparatus, Sea water, Aeration, Calcium carbonate, Lime.

Identifiers: *Pacificification, Virgin Islands, Key West (Florida).

To inhibit corrosion and reduce contamination by metal pickup, treatment of the product water for distillation plants is required. The literature was reviewed for corrosion inhibition methods suitable for potable water. Previous work at the Office of Saline Water test facilities was reviewed and a survey of the 'state of the art' of product water treatment was conducted for several privately owned plants in the Caribbean. It was concluded that calcium carbonate stabilization is generally the most satisfactory corrosion inhibitor. The economics is considered of several methods of achieving a stable water containing 30 to 80 ppm of calcium alkalinity expressed as calcium carbonate, and a minimum of 5 ppm of dissolved oxygen. If naturally hard water is unavailable for blending, the cheapest method for large plants (S 10 Mgd) at most localities is blending with a calcium carbonate solution prepared by absorption of carbon dioxide in a lime slurry. The estimated costs for calcium carbonate stabilization of product water from distillation plants are approximately 1.8 cents/1,000 gals. for a 10 Mgd plant and 1.4 cents/1,000 gals. for a plant producing 50 Mgd. (OSW abstract)

W72-01835

FIELD EVALUATION OF FORCED-FLOW ELECTRODESLALINATION, Southern Research Inst., Birmingham, Ala.

Thomas A. Davis, and Robert E. Lacey.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$0.70. Office of Saline Water Research and Development Progress Report No. 710, August 1971, 73 p, 28 fig, 3 tab. Contract No. 14-01-0001-1167.

Descriptors: *Brackish water, *Desalination, *Desalination apparatus, *Desalination process, *Electrodialysis, *Membrane processes, Bicarbonates, Calcium carbonate, Calcium sulfate, Electrodes, Estimated costs, Permeselective membranes, Saline water, Separation techniques, Sulfates.

Forced-flow electrode desalination (FFED), a variation of electrodialysis, was evaluated with two natural brackish waters, one with high Ca (HC03)2 and NaCl content and the other with high CaSO4 content. An FFED stack, an Aqua-Chem WD 10-4 electrodialysis stack, and auxiliary equipment were installed in a mobile test facility. Both stacks were operated for extended periods at each well site. Total operating time was approximately 3600 hours. As expected, precipitates formed in both stacks when limiting current densities were exceeded. Limiting values of current density and degree of demineralization with the FFED stack were approximately twice the values attainable with the Aqua-Chem stack. Cost estimates based

on experimental results indicated significantly lower costs in large-scale electrodialysis plants if FFED stacks are used. Graphite anodes originally installed in both stacks deteriorated during field operations, so they were replaced with platinum-titanium anodes which performed satisfactorily. An inexpensive anode, lead dioxide-coated graphite, was tested in the FFED stack at current densities up to 50 ma/sq cm for 450 hours with very promising results. (OSW abstract)

W72-01836

IN-SITU REGENERABLE MEMBRANES FOR REVERSE OSMOSIS, Stanford Research Inst., Irvine, Calif.

F. E. Littman, H. Bishop, and R. McMillen.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$0.60. Office of Saline Water Research and Development Progress Report No. 701, Sep 1971, 53 p, 30 fig, 17 tab. Contract No. 14-30-2539.

Descriptors: *Reverse osmosis, *Membrane processes, Desalination, Demineralization, Membranes.

Identifiers: *Cellulose acetate, *Regeneration of membranes, In-situ regeneration, Tubular membranes, Porous ceramic support.

The regeneration of a sealed reverse osmosis system was accomplished by removal of the spent membrane with a solvent and deposition of a new one from a casting solution. The removal-redeposition was carried through six cycles, in duplicate. Each of the modules was run for 1-2 weeks on 3,000 ppm salt solution at 600 psi between regenerations. Rejection averaged 90% with a flux of 13 gfd (gal/sq ft. day). There was no deterioration of performance through the six cycles, demonstrating the usefulness of the in situ deposition concept. The membrane support material used throughout most of this study was porous ceramic tubes, which performed well and which are available at an acceptable cost. One of the advantages of the in situ regenerable membranes is that different types of membranes can be deposited, covering a range of fluxes and salt rejections. Fluxes for different membranes investigated in this study ranged from 4 to 40 gfd, salt rejections from 55% to 97%. Thus, a variety of requirements can be met by using cellulose acetate, cellulose triacetate, or acetate-butyrilate membranes. (OSW abstract)

W72-01837

MODEL STUDIES OF OUTFALL SYSTEMS FOR DESALINATION PLANTS (PART I - FLUME STUDY), Army Engineer Waterways Experiment Station, Vicksburg, Miss.

For primary bibliographic entry see Field 05E. W72-01838

IMPROVING MUNICIPAL WATER SUPPLIES IN COLORADO BY DESALTING, URS Research Co., San Mateo, Calif. and White (Ken R.) Co., Denver, Colo.

F. J. Agard, and Henry Daubert.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Price \$1.00. Office of Saline Water Research and Development Progress Report No. 702, June 1971, 114 p, 21 fig, 20 tab, 4 ref. OSW-14-01-0001-2581.

Descriptors: *Colorado, *Water quality, *Water treatment, *Desalination, *Feasibility, *Cost analysis, Water supply, Municipal water, Potable water. Identifiers: *Brighton (Colo), *Ft. Morgan (Colo), *Las Animas (Colo), *Ft. Lupton (Colo), *La Junta (Colo), *Lamar (Colo).

This is a preliminary engineering and economic assessment of the feasibility and cost of applying various desalting techniques to improve the quality of

community water supplies in the high plains region of Colorado. Six Colorado communities, viz. Brighton, Ft. Lupton, Ft. Morgan, La Junta, Las Animas, and Lamar, were selected by the Colorado Water Conservation Board as the candidates for assessment. It was found that several desalting methods are technically feasible for use at each community to correct water quality deficiencies. A prerequisite to final determination of the specific process that would best serve each community would be the performance of a more rigorous engineering analysis, the development of engineered plans, and the procurement of estimates from reputable desalting plant vendors. On a battery limits basis, the water quality improvement costs as developed in this study range from a low of 37 cents per 1000 gallons for supplying 2.6 MGD to Ft. Morgan to a high of 57 cents per 1000 gallons for supplying 1.4 MGD to Las Animas. The added costs of feedwater supply, product water distribution and brine disposal are included. (OSW abstract)

W72-01839

THE DESIGN, FABRICATION AND TESTING OF A 1000 GALLON PER DAY TUBULAR REVERSE OSMOSIS PILOT PLANT, American Standard Inc., New Brunswick, N.J. E. A. G. Hamer.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, \$1.00. Office of Saline Water Research and Development Progress Report No. 424, May 1969, 99 p, 23 fig, 6 tab, 10 ref. OSW Contract 14-01-0001-1171.

Descriptors: *Reverse osmosis, *Membranes, *Desalination plants, *Pilot plants, Tubes, On-site tests, Brackish water.

Identifiers: Cellulose acetate.

The design was based on 10 modules, each comprising 14 tubular membrane elements of 0.5 in. diameter and 4 ft. length mounted between circular tube sheets, and each containing 7.3 ft of replaceable cellulose acetate membranes. Also incorporated into the design were turbulence promoters in 8 of the modules and a valving system between them, so that the unit could operate effectively at potable water recoveries from 50 to 85% over a feed water salinity range of 1000 to 4000 ppm. As part of the construction phase, facilities were developed for preparing the module components including membranes, which were subsequently assembled and tested prior to being installed as part of the pilot unit in a van. The unit desalts well water containing 3500 ppm dissolved solids under a pressure of 600 lb/in at a potable water recovery of 70%. Over 6 months of operation the steady state performance equalled or exceeded design specifications, the output being 1000 gal/day or more of potable water containing in the region of 300 ppm salts. The drop in membrane water flux during this time was less than 10%, of which nearly all occurred in the initial 3 months and to some extent accompanied the variation in the brackish feed water temperature. No significant deterioration in product water quality was observed. The unit's capability to operate at pressures up to 1000 lb/sq in was demonstrated.

W72-02045

MEMBRANES FOR DESALINATION BY REVERSE OSMOSIS, Amicon Corp., Cambridge, Mass. L. L. Markley, R. A. Cross, and H. J. Bixler.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$0.60. Office of Saline Water Research and Development Progress Report No. 281, December 1967, 92 p, 17 fig, 17 tab, 18 ref. 14-01-0001-655.

Descriptors: *Desalination processes, *Membrane processes, *Reverse osmosis, *Pre-treatment (Water), Cellulose.

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Saline Water Conversion—Group 3A

Identifiers: *Feed water, Cellulose acetate, Polyelectrolyte membranes, Bovine serum albumin, Dextran, Alkyl benzene sulfonate, Ferric hydroxide.

Salt leakage through cellulose acetate membranes may take place through regions of very low polymer density or 'defects' in the membrane. Research was carried out to increase the salt rejection efficiency by selectively eliminating defects which are ion permeable. Only slight improvement was noted by precipitating insoluble salts within the membrane. The addition of water soluble polymers to the saline feed stream, however, was quite effective. Polyvinyl methyl ether was extremely effective in increasing salt rejection efficiency, and the effect persisted for at least 24 hours after removal of the additive from the saline feed. Copolymers of polyethylene oxide and polypropylene oxide were also very effective. These additives tend to 'precipitate' or strongly absorb on the membrane where they form a second barrier membrane acting in series with the barrier layer of cellulose acetate. Diaflo® polyelectrolyte membranes were evaluated as a means for removing from brine solutions suspended particulate colloidal and soluble high molecular weight contaminants which would not be removed by conventional feed pretreatment processes employed in desalination plants. Bovine serum albumin, dextran, alkyl benzene sulfonate, colloidal ferric hydroxide, and polyvinyl methyl ether were used as simulants for contaminants which could be found in sea water or brackish water. The Diaflo membranes rejected well over 90% of each of the contaminants and generally enhanced subsequent performance of cellulose acetate reverse osmosis membranes.

W72-02046

LARGE REVERSE OSMOSIS SYSTEM TECHNOLOGY AND MODULE DEVELOPMENT,

Gulf General Atomic Inc., San Diego, Calif.

A. B. Riedinger, J. K. Laughlin, and R. G. Sudak. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402 Price \$0.65. Office of Saline Water Research and Development Progress Report No. 341, June 1968, 73 p., 30 fig., 10 tab. 14-01-0001-929.

Identifiers: *Reverse osmosis, *Membranes, *Brackish water, Desalination plants, *Pilot plants, Cellulose.

Identifiers: Cellulose acetate, *Spiral wound module.

The objective was the design and fabrication of a 10,000 gpd spiral-wound module reverse osmosis unit for operation on brackish waters. This is the largest spiral-wound pilot plant sponsored by the OSW program. As a basis for the plant design extensive development work on larger spiral-wound modules is described. A 3-ft. module, with 34 sq ft of cellulose acetate membrane was selected for the plant. Photographs of the unit and preliminary operating data on 4730 ppm brackish water are included. Module construction and design features are discussed. (OSW abstract)

W72-02047

THERMODYNAMIC PROPERTIES OF WATER TO 1,000C AND 10,000 BARS,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 01A.
W72-02048

DEVELOPMENT OF NEW AND IMPROVED CELLULOSE ESTER REVERSE OSMOSIS MEMBRANES,
Aerojet General Corp., El Monte, Calif.

C. W. Saltonstall. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$1.25. Office of Saline Water Research and Development Progress Report No. 434, June 1969, 154 p., 33 fig., 39 tab., 23 ref. OSW Contract 14-01-0001-1732.

Identifiers: *Reverse osmosis, *Membranes, *Sea water, *Desalination, Semipermeable membranes, Membrane processes, Ion transport, Separation techniques, Cellulose.

Identifiers: Cellulose acetate, Cellulose acetate-methacrylate, High salt rejection, Cellulose esters, Crosslinking, Flux decline.

High retention membranes having fluxes of 8 to 11 gfd and sodium chloride rejections of 99.4 to 99.75% have been made from a variety of cellulose esters including blends of cellulose diacetate and triacetate, homopolymer cellulose acetate and several mixed acetate esters (propionate, butyrate and methacrylate). In all cases, the d_s range of the polymer (s) used was 2.6 plus or minus 0.05. Furthermore, the rates of flux decline of several types of the aforementioned membranes, are sufficiently low to project satisfactory one-year operation. It can be concluded therefore, that the membrane technology is available to permit single-pass seawater desalination by reverse osmosis. Cross-linked cellulose ester membranes have been made with osmotic and mechanical properties superior to the uncrosslinked precursors, and with exceptionally low flux declines. This particular discovery requires study to realize its full potential. Since water and salt permeability increase regularly with decreasing d_s , polymers in the correct range of d_s , crosslinked for stability, should yield high flux membranes with preselected salt retention. The propensity of membrane imperfections to close under pressure has been demonstrated by dyeing experiments. In addition, the high initial diffusive permeability of most membranes has been shown by experiments with both dye and salt. These experiments cast doubt upon the usefulness of values of reflection coefficients determined with unpreserved membranes. Alternative experimental methods should be sought for characterizing membranes under pressure. (OSW abstract)

W72-02049

FINAL REPORT ON CONTROL OF CONCENTRATION POLARIZATION IN REVERSE OSMOSIS DESALINATION OF WATER,

Amicon Corp., Lexington, Mass.

H. J. Bixler, and R. A. Cross.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$0.60. Office of Saline Water Research and Development Progress Report No. 469, October 1969, 57 p., 13 fig., 4 tab., 7 ref. OSW 14-01-0001-964.

Identifiers: *Reverse osmosis, *Boundary layers, *Desalination, *Osmosis, *Laminar flow, *Turbulent flow, Membranes, Cellulose.

Identifiers: *Concentration polarization, *Thin channel flow, *Cellulose acetate.

The overall objectives have been to experimentally examine concentration polarization in laminar and turbulent flow reverse osmosis systems. Concentration polarization in relatively ideal channel geometries has been measured and compared with theoretical developments coming out of other OSW-sponsored programs. In addition, the effects of channel distortions, and other flow nonidealities, have also been studied for their influence on concentration polarization. Primarily the turbulent flow studies and those laminar flow studies concerned with flow non-idealities are covered. The effects were measured of feed salt concentration, feed fluid velocity, product water recovery, and channel length on concentration polarization in channels of uniform cross-section. (OSW abstract)

W72-02107

ELECTRODIALYSIS DESALTING STATE-OF-THE-ART (1969).

Hittman Associates, Inc., Columbia, Md.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$0.55. Office of Saline Water Research and Development Report No. 610, October 1970, 46 p., 8 fig., 23 ref. OSW Contract 14-01-0001-1748.

Identifiers: *Electrodialysis, *Desalination, Separation techniques, Physicochemical properties, *Economic feasibility, Water treatment.

The report reviews current technical and engineering economic aspects of the electrodialysis (ED) desalting process based upon current literature, manufacturers' equipment data, and plant operating results. ED has been established as an efficient and reliable process for the desalting of brackish feedwaters. Plants with capacities in excess of one million gallons per day (1 MGD) have been built and successfully operated. Estimates are made of the capital cost and plant water costs resulting from plants with capacities extending from 0.5 to 50 MGD. The cost of desalting brackish water with salinities in the range of 1000 - 2500 ppm and capacities from 5 - 50 MGD may be as low as 20 - 30 cents/1000 gallons. (OSW abstract)

W72-02108

THE INFLUENCE OF MODEL MEMBRANE SYSTEMS ON THE STRUCTURE OF WATER,

North American Rockwell, Canoga Park, Calif.

W. V. Johnston, and J. Greson. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 Price \$0.50. Office of Saline Water, Research and Development Progress Report No. 707, August 1971, 41 p., 3 fig., 4 tab., 25 ref. OSW Contract No. 14-30-2599.

Identifiers: *Thermodynamics, *Water properties, *Heavy water, Biological properties, Enthalpy, Physicochemical properties, Membrane processes, Reverse osmosis, Cellulose, Desalination.

Identifiers: Heats of solutions, Model membrane compounds, Calorimetric measurements.

Enthalpies of transfer between heavy and normal water for several compounds which serve as model compounds for cellulose-cellulose acetate reverse osmosis membranes were determined from heats of solution and dilution measured calorimetrically. The compounds investigated included urea, alpha and beta methyl glucoside, alpha and beta pentaacetate, alpha maltose and beta cellobiose. The hydrogen atoms on the hydroxyl groups of the compounds were exchanged for deuterium and the heats of solution and dilution for the deuterated compounds were also measured. Urea was found to be a structure breaker and all the saccharides were structure breakers. The degree of structure making increased as hydroxyl groups were substituted for hydroxyl groups. (OSW abstract)

W72-02109

NEW AND IMPROVED CELLULOSE ESTER MEMBRANES,

Envirogenics Co., El Monte, Calif.

D. L. Hoernschemeyer, R. W. Lawrence, C. W. Saltonstall, Jr., O. S. Schaeffer, and A. J. Secci. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Price \$1.00. Office of Saline Water Research and Development Progress Report No. 700, September 1971, 100 p., 15 fig., 42 tab., 13 ref. OSW Contract 14-01-0001-2205.

Identifiers: *Reverse osmosis, *Membranes, *Permeselective membranes, Osmosis, Membrane processes, Sea water, Desalination, Demineralization, Semipermeable membranes, Separation techniques, Cellulose.

Identifiers: Cellulose acetate, *Cellulose acetate-methacrylate, *Cellulose acetate homopolymer, *Flux decline, Crosslinked membranes, High retention membranes, Casting formulations.

Asymmetric membranes were developed with maximum flux and improved useful life, suitable for the production of potable water from seawater and various brackish waters. Membranes having especially high promise cellulose acetate blend membranes for brackish water and seawater; homopolymer cellulose acetates with a degree of substitution of 2.3 or 2.6; and cellulose acetate methacrylate (CAM) membranes for greatly im-

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

proved flux stability. The biggest single advance was made with CAM membranes which have exhibited high flux and salt rejection along with essentially zero flux decline at 800 psi. This singular achievement was realized by synthesizing a highly substituted material and by developing a greatly improved crosslinking technique. Optimal high-viscosity casting formulations were developed to give essentially defect-free blend membranes with high fluxes when cast with zero drying. These optimal formulations were developed by a systematic variation in the components of the casting solution. The best flat-sheet membranes exhibited 38 gfd at 95% rejection, 50 gfd at 90% rejection, and 57 gfd at 85% rejection from 1% sodium chloride solution at 800 psi. (OSW abstract)
W72-02111

THE SIMULATION AND OPTIMIZATION OF A SINGLE EFFECT MULTI-STAGE FLASH DESALINATION PLANT, Stanford Univ., Calif.

For primary bibliographic entry see Field 06A.
W72-02131

3B. Water Yield Improvement

HYDROLOGIC FACTORS IN THE DETERMINATION OF WATERSHED YIELDS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W72-01700

MULTI-SITE STREAMFLOW SIMULATION OF TRUCKEE RIVER, NEVADA,
Nevada Univ., Reno. Center for Water Resources Research.
For primary bibliographic entry see Field 02E.
W72-01778

PRELIMINARY STUDY OF THE DEVELOPMENT OF WATER RESOURCES OF THE HU-MACAO SUB-REGION, PUERTO RICO.
Black and Veatch International, Kansas City, Mo.
For primary bibliographic entry see Field 06D.
W72-01829

AN EXTENDED THEORY OF DELAYED YIELD FROM STORAGE APPLIED TO PUMPING TESTS IN UNCONFINED ANISOTROPIC AQUIFERS,
Sheffield Univ., (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 04B.
W72-02011

OUTLINE OF A BAYESIAN APPROACH TO THE EML MULTIPLE CLOUD SEEDING EXPERIMENTS,
National Oceanic and Atmospheric Administration, Boulder, Colo. Experimental Meteorology Lab.

J. Simpson, and J. Pezier.
Available from the National Technical Information Service as COM71-00875, \$3.00 in paper copy, \$0.95 in microfiche. National Oceanic and Atmospheric Administration Technical Memorandum ERL OD-8, June 1971. 43 p, 5 fig, 19 tab, 9 ref, append.

Descriptors: *Rainfall, *Cloud seeding, *Artificial precipitation, *Evaluation, *Florida, Analytical techniques, Mathematical studies, Equations, Computer programs, Theoretical analysis, Hydrologic data.
Identifiers: Decision analysis, Bayes equation.

Decision analysis techniques, using Bayes equation in several forms, are evolved for use in analyzing NOAA's Florida cumulus seeding experiments, particularly the randomized multiple cumulus ex-

periment begun in 1970 south of Lake Okeechobee. In order to apply decision analysis to evaluate the seeding effect upon rainfall, it is necessary to know the distribution and its sufficient statistics for both seeded and natural rain. It is desirable to know these for both the total target and for a 'floating target' which consists of the 'seeded' cloud complexes and those neighboring clouds which merge with them. Lacking this knowledge, several assumptions were made for use in the evolution of the Bayesian approach. The fourth root of the single cloud rainfall (transformed data) fits a gamma distribution for both seeded and control cases. Seeding changes the mean but not the shape of the distribution. Using the same assumption for the area cases and assuming a natural mean from the one fair day control case available from 1970, simple and composite hypothesis testing were used to estimate the seeding effect on rainfall. Analyses suggest a seeding effect of a factor of 2-3 for the floating targets. (Woodard-USGS)
W72-02058

COMPLEXES OF SILVER IODIDE AND SECONDARY AMINES,

Naval Weapons Center, China Lake, Calif.
G. B. Ansell, L. A. Burkhardt, and W. G. Finnegan.
Available from NTIS, Springfield, Va 22151 AD-727 238Price \$3.00. Naval Weapons Command Technical Publication 5168, May 1971, 5 p, 5 fig, 6 ref, (Includes 3 papers reprinted from Chemical Communications, 1969, Chemical Society, London). ZR 01101/ZR 0110101.

Descriptors: *Weather modification, *Silver iodide, *Atmosphere, *Chemical reactions, *X-ray analysis, Cloud seeding, Chemistry of precipitation, Precipitation (Atmospheric), Storms, Cloud physics, Meteorology, Analytical techniques.
Identifiers: *Chemical structures, Secondary amines.

X-ray analysis were made to determine the crystal structure of complexes between silver iodides and such secondary amines as piperidine, morpholine, and piperazine, to establish the role of silver iodide and related compounds when they act as ice nuclei in supercooled clouds and fogs. This is part of the Naval Weapons Center's research program to develop an understanding of the physical chemistry involved in weather modification processes. Such an understanding will contribute significantly to the development of methods and materials for the control of atmospheric phenomena such as rain, hail, snow, fog, stratus clouds, and severe storms. (Woodard-USGS)
W72-02072

PROGRESS IN DEVELOPING FOREST MANAGEMENT GUIDELINES FOR INCREASING SNOWPACK WATER YIELDS,
Arizona Univ., Tucson. Dept. of Watershed Management.

For primary bibliographic entry see Field 04A.
W72-02230

3C. Use of Water of Impaired Quality

POTENTIAL PLANT PATHOGENIC FUNGI IN SEWAGE AND POLLUTED WATER,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Water Supply and Water Pollution Program.
For primary bibliographic entry see Field 05C.
W72-01809

WASTEWATER TREATMENT AND RE-USE OF TREATED SEWAGE AS AN INDUSTRIAL WATER SUPPLY,

Imperial Smelting Corp. Ltd., Avonmouth (England).
For primary bibliographic entry see Field 05D.
W72-01860

MODIFICATION OF CARCASS CHARACTERISTICS IN SHEEP MAINTAINED ON A SALINE WATER REGIME,

C. S. I. R. O., Div. Nutr. Biochem., Adelaide, S. Aust. Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Nutritional Biochemistry.
D. J. Walker, B. J. Potter, and G. B. Jones.
Aust J Exp Agr Anim Husb. 11 (48): 14-17. 1971.
Identifiers: Body, Carcass, Fat, Hay, Lucerne-D, Maintained, Modification, Protein, Regime, Saline, Sheep.

Two groups each of 4 Merino wethers, 2 yr old and in very lean condition after many weeks on a straw ration, were fattened on a ration of lucerne hay. One group of animals drank 1.3% sodium chloride solution for 16 wk before and during fattening while the control group drank tap water throughout. Analyses done after body weight increases of about 12 kg showed that, compared to the controls, the saline drinking group had significantly less fat, more water, and more protein in the edible carcass. All differences were significant. Samples of fat from the omentum and perirenal area showed a tendency towards a higher degree of unsaturation in the saline-drinking animals although these results were not statistically significant.—Copyright 1971, Biological Abstracts, Inc.
W72-01958

QUALITY OF IRRIGATION WATERS OF KANJHWALA AND ALIPUR BLOCKS OF DELHI IN RELATION TO SOIL PROPERTIES AND GROWTH OF WHEAT,

Udaipur Univ. (India). Agricultural Experiment Station.
K. V. Paliwal, and Raghbir Singh Dinesh.
Ann Arid Zone. 9 (2): 85-93. 1970.
Identifiers: Alipur, Blocks, Delhi, Growth, India, Irrigation, Kanjhwala, Relation Soil, Wheat-M.

Thirty representative irrigation waters were collected from wells to examine quality and the effect on soil properties. The growth of wheat revealed that none of the classifications was fully applicable for judging the suitability of the water for wheat. Growth was very poor at some levels of electrical conductivity of the saturation extract and Na saturation of 22.1%. In spite of using highly saline irrigation waters, these soils are not much salinized or sodiumized due to flooding conditions. While judging the suitability of irrigation waters due consideration should be given to topography, drainage characteristics and moisture relationships. There was no equilibrium between irrigation water and soil solution and indices based on saturation extract could predict better than quality of irrigation waters.—Copyright 1971, Biological Abstracts, Inc.
W72-01964

AGRICULTURAL UTILIZATION OF SEWAGE EFFLUENT AND SLUDGE, AN ANNOTATED BIBLIOGRAPHY,

Robert S. Kerr Water Research Center, Ada, Okla.
For primary bibliographic entry see Field 05G.
W72-02104

3D. Conservation in Domestic and Municipal Use

WATER RESOURCES POLICY IN WISCONSIN: A SUMMARY ASSESSMENT, VOLUME 1,

Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 06E.
W72-01979

OPTIMIZATION IN MUNICIPAL WATER SUPPLY SYSTEM DESIGN,

Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W72-02125

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Conservation in Agriculture—Group 3F

EMPIRICAL STUDY OF ECONOMIC-ECOLOGIC LINKAGES IN A COASTAL AREA,
Clemson Univ., S.C. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 06A.
W72-02126

COMPARISON OF WATER PRICING STRUCTURES FROM A COLLECTIVE UTILITY VIEWPOINT,
Arizona Univ., Tucson. Dept. of Systems Engineering.
For primary bibliographic entry see Field 06C.
W72-02233

3F. Conservation in Agriculture

EFFECTS OF RECENT AND PAST PHOSPHATE FERTILIZATION ON THE AMOUNT OF PHOSPHORUS PERCOLATING THROUGH SOIL PROFILES INTO SUBSURFACE WATERS,
Missouri Univ., Columbia. Dept. of Agronomy.
For primary bibliographic entry see Field 02G.
W72-01691

THE EFFECT OF BURR BURIAL ON THE SEED OF SOME EARLY MATURING SUBTERRANEAN CLOVER CULTIVARS,
Department of Agriculture, South Perth (Australia).

B. J. Quinlivan, and C. M. Francis.

Aust J Exp Agr Anim Hub. 11 (48): 35-38. 1971.
Identifiers: Australia, Burial, Burr, Clover-D, Cultivars, Early, Maturing, Seed, Subterranean, Trifolium-Subterraneum-D.

Seven early maturing cultivars of subterranean clover (*Trifolium subterraneum*) showed large between cultivar differences in terms of burr and seed development above the soil surface. The indices used for determining differences between buried and unburied burrs were burr and seed weight, and seed viability and impermeability. With all cultivars seed formed above the soil surface weighed less and had a lower viable and impermeable seed content. The results are discussed in terms of the selection and breeding of subterranean clover cultivars suitable for the low rainfall agricultural regions of Western Australia.—Copyright 1971, Biological Abstracts, Inc.
W72-01736

FERTILITY STUDIES OF PASTURE SOILS IN THE WET TROPICAL COAST OF QUEENSLAND: I. SOIL-VEGETATION CLASSIFICATION UNITS,
Department of Primary Industries, South Johnston (Australia). Research Station.
J. K. Teitel, and R. C. Bruce.
Aust J Exp Agr Anim Hub. 11 (48): 71-76. Illus. 1971.
Identifiers: Australia, Classification, Coast, Fertility, Pasture, Queensland, Soils, Tropical, Vegetation.

To provide a natural framework for presenting and extrapolating results from a series of soil fertility studies in the wet tropical coast region of Queensland, 6 major soil groups, and 11 major vegetation units were recognized and described. Not all vegetation associations were represented on each soil type and only 48 soil-vegetation units occurred in the region.—Copyright 1971, Biological Abstracts, Inc.
W72-01737

DROUGHT INFLUENCE ON GERMINATION AND SEEDLING EMERGENCE,
Agricultural Research Service, Tucson, Ariz. Plant Science Research Div., and Arizona Univ., Tucson. Dept. of Agronomy.
L. N. Wright.

In Drought Injury and Resistance in Crops, Larson, K. L. and Eastin, J. D. (eds.), CSSA Special Publication No. 2, p 1-18, 1971. 1 tab, 204 ref.

Descriptors: *Seeds, *Germination, *Drought resistance, *Plant growth, Planting management, Soil-water-plant relationships, Agronomy, Arid lands, Crops, *Soil moisture, Environmental effects, Mode of action, Plant breeding.
Identifiers: *Seedlings, *Seed dormancy.

Drought can be severe in humid environments, but its influence on germination and seedling emergence is most pronounced in semiarid and arid regions. In no other environment are a germinating seed and seedling subjected to such demanding and fluctuating influences. Research to develop germplasm and cultural techniques for improved germination and seedling vigor for stand establishment of seeded desert grasslands presents many knotty problems. Mainly, these involve the identification and understanding of various components of the germination and growth processes and how selective plant breeding can be utilized in maximizing their contributions to establishment and survival to maturity. Environmental stresses, primarily limited soil moisture and high soil temperatures are especially critical in desert regions. Various seed and seedling factors are reviewed and summaries of the current state of knowledge concerning their mechanisms and possible improvement by selective breeding are presented. These include vigor, seed food reserves, seed age, biochemical activity, and germination inhibition. (Casey-Arizona)
W72-01739

SUGAR BEETS IN ARIZONA,
Arizona Agricultural Experiment Station, Tucson. R. E. Dennis, and J. M. Nelson.
University of Arizona, Cooperative Extension Service and Agricultural Experiment Station, Bulletin A-71, 6 p., March 1971. 9 fig.

Descriptors: *Sugar beets, *Seeds, *Sugarcane, *Crop production, *Irrigation practices, Soil moisture, Soil physical properties, Weeds, Herbicides, Fertilization, Weed control, Insects, Plant diseases, Harvesting, Soil temperature, Emerging vegetation stage, Plant growth, Consumptive use, Irrigated land, Elevation, Valleys, Arizona.

Sugar beets, adapted to irrigated valleys at all elevations in Arizona, are produced for beets, and less abundantly for seed. Half the national seed supply is Arizona produced. Deep, well drained loams or clay loams, with short irrigation runs, free of nematodes and perennial weeds and herbicide residues produce best sugar crops. Site selection, seedbed preparation, seed, planting date, plant in rows, fertilization, thinning, irrigation, weed control, insects, diseases, and harvesting are discussed. Irrigation keeps surface soil moist, controls soil temperature, prevents crusting, controls salt accumulation, and speeds emergence and growth. Crops are preirrigated to a depth of 5 or more feet, followed by a tapering off of irrigation. Consumptive use is about 3 1/2 acre feet of water per acre in full season. (Poplin-Arizona)
W72-01742

ENERGY BALANCE AND SPECTRAL PROPERTIES OF A REFLECTORIZED SOYBEAN CANOPY,
Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry.
P. C. Doraiswamy.
University of Nebraska, Agricultural Experiment Station, Horticulture Progress Report 88, 189 p., June 1971. 83 fig, 18 tab, 90 ref.

Descriptors: *Energy budget, *Spectroscopy, *Soybeans, *Canopy, *Crop production, Consumptive use, Water conservation, Population, Radiation, Hydrologic data, Meteorological data, Climatic data, Limiting factors, Evaluation, Evapotranspiration, Optical properties, Photosynthesis, Analysis, Light, Interception, Dis-

tribution patterns, Transpiration, Soil physical properties, Plants, Lysimeters, Carbon dioxide, Diffusivity, Kaolinite, Water vapor, Treatment, Water utilization.

Growing crops for a maximum yield with minimum use of water is the most fundamental necessity for a rapidly growing world population. Consumptive use is related to net radiation, the most important meteorological factor. This study evaluates the possibility of reducing plant transpiration by altering the plant reflection characteristics. The study consists of soybean spectral, energy balance, field photosynthesis, and agronomic analysis. Reflectant material, vegetation optical properties, light interception, radiative distribution, transpiration, photosynthesis, radiation and energy balances, climate, soil and plant observations, leaf resistance and stomatal impressions, meteorological observations, lysimetric evapotranspiration, carbon dioxide flux, diffusivity, and soil water are discussed. Energy balance and water-use efficiency of plants are characterized by their spectral properties. Kaolinite-treated canopy had major effect on light reflection in the visible wavelengths, but did not alter spectral light reflected. Energy balance results show a significant reduction in the water-vapor flux over the treated crop. A decrease in water use by the treated crop is evidenced. Abundant figures and tables quantify relationships. There are 90 references. (Poplin-Arizona)
W72-01747

LYSIMETRIC AND ENERGY BALANCE DETERMINATION OF SLATFENCE AND TREE WINDBREAK EFFECTS ON WATER USE EFFICIENCY,
Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry.
For primary bibliographic entry see Field 02D.
W72-01748

CAN WE BREED FOR DROUGHT RESISTANCE,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
E. A. Hurd.

In: Drought Injury and Resistance in Crops, Larson, K. L. and Eastin, J. D. (eds.), CSSA Special Publication No 2, p 77-88, 1971. 3 fig, 27 ref.

Descriptors: *Plant breeding, *Drought resistance, *Plant growth, *Semiarid climates, *Productivity, Crop response, Root systems, Drought tolerance, Agronomic crops, Plant physiology, Soil-water-plant relationships, Genetics, Crop production, Plant populations.
Identifiers: *Seedlings.

It is asserted that plant breeding for drought resistance has been a moribund field for some time but there is much yet to be done. This paper concentrates on the principles of breeding for yield in semiarid climates. Plus genes that are plus in a semiarid climate should be accumulated by growing large populations and running early generation yield tests (F sub 3 on) under typical dry growing conditions. A plant breeder needs a large experienced staff, and without such a staff, a breeder with increasing yield as an objective is under-employed. In breeding for drought resistance it is more important to breed for maximum yield in the most adverse year rather than highest yield in a good year. The most important agronomic selection criterion is rapid early development from emergence to heading, which is an effective drought escape mechanism. The elimination of tillering is also important. So far, no one has found a method of measuring desiccation tolerance, but advances in plant physiology should eventually facilitate advances in this area. Differences in root system response to available moisture are also critical selection criteria. (Casey-Arizona)
W72-01757

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation in Agriculture

DROUGHT INFLUENCE ON PHYSIOLOGICAL PROCESSES AND SUBSEQUENT GROWTH,
California Univ., Davis. Dept. of Agronomy and Range Science.

H. M. Laude.

In: *Drought Injury and Resistance in Crops*, Larson, K. L. and Eastin, J.D. (eds.), CSSA Special Publication No 2, 45-56, 1971. 4 fig, 1 tab, 33 ref.

Descriptors: *Moisture stress, *Drought resistance, *Water balance, *Crops, Plant growth, Agronomy, Stress, Plant physiology, Soil-water-plant relationships, Crop production, Crop response.

During physiological stress brought upon by drought, growth retardation is generally noted in plants. Agronomists, in particular, have paid attention to the influence of dryness on different stages of growth. The concept of 'critical stages' has been much emphasized; that is, those times in development when injury from a given stress is greater than at other times. Following mild stress, subsequent development under favorable conditions may compensate for injury, but after intensified stress, injury is more persistent. Agronomists have tended to use a survival approach in studies of drought injury and resistance. The concepts of growth and yield are different, for often, as in the case of fruits, yield is only a portion of the total crop growth. The drawback of the survival approach is that survival does not tell us if the plant retains the potential to grow and yield the product we want. Additionally, most studies of plant recovery after drought stress measure various parameters of recovery exactly 1 week after stress. It is asserted that assessing the effects of moisture shortage only at one point in time may fail to reveal the true nature of growth after stress and that we must evaluate growth subsequent to stress and over time as a reflection of both the injury and the recovery. (Casey-Arizona)

W72-01758

EFFECTIVE DROUGHT CONTROL FOR SUCCESSFUL DRYLAND AGRICULTURE,
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.

F. G. Viets, Jr.

In: *Drought Injury and Resistance in Crops*, Larson, K. L. and Eastin, J. D. (eds.), CSSA Special Publication No 2, p 57-76, 1971. 6 fig, 3 tab, 57 ref.

Descriptors: *Semiarid climates, *Dry farming, *Water conservation, *Drought resistance, *Crop response, Shelterbelts, Snowmelt, Fallowing, Great Plains, Precipitation (Atmospheric), Soil moisture, Fertilizers, Nitrogen, Arid lands, Evaporation, Transpiration, History, Microhabitats, Cloud seeding.

Identifiers: *Antitranspirants.

The only really effective drought control is more rain or irrigation, but in arid and semidesert areas, irrigation is often unfeasible for various reasons and rainfall is not only scarce but usually extremely unevenly distributed in time. Cloud seeding may have some promise for high watershed areas, but in arid and semiarid regions the simple lack of clouds limits its possibilities. Development of methods of stretching limited water supply and the selection of crops and special cultural practices for them has permitted the extension of agriculture into semiarid areas that once were popularly called deserts, such as the Great Plains of the U.S. Success or failure, which still depends on the erratic precipitation, has been accomplished by trial and error. The kind of crop that can be grown depends on the total water demand, the timing of the need in relation to supply and sometimes on the ability of the crop to endure drought without damage. This is in addition to correct temperature conditions and to market availability. Much of the agriculture in semiarid regions depends on forage and grain crops. The importance of stored moisture in the spring at seeding time is recognized and various techniques for assuring this are reviewed: fallowing, use of thin stands, antitranspirants, land-shaping for snowmelt conservation and greater runoff, shelterbelts and appropriate crop selection. (Casey-Arizona)

W72-01759

AGAINST MONOCULTURE,
Florida Univ., Gainesville. Dept. of Geography. M. U. Igbozurike. Professional Geographer, Vol 23, No 2, p 113-117, April 1971. 2 fig, 9 ref.

Descriptors: *Agriculture, *Crop response, *Cultivated lands, *Cultural control, *Biological communities, Pesticides, Fertilizers, Crop production, Economic impact, Ecosystems, Economics of scale, Soil structure, Soil environment, Soil contamination, Fertility, Environmental effects, Mode of action.

Identifiers: *Crop monoculture, *Mixed cropping.

There is a slowly emerging realization that most of the so-called modern output operations of food and fiber production are myopically committed to short-term success. This is mainly due to monoculture—the cultivation of a single crop in a given unit of space and time. Because of the visible 'success' of the North American and Western European monocultural farming systems, the dangers of monoculture are ordinarily only slightly, or not at all mentioned in textbooks of agricultural economics or economic geography. Such dangers may be subdivided into 2 categories: social and biological. Biologically, the destruction of natural vegetation diversity and its replacement by floristic uniformity rapidly leads to fertility depletion and increased pestilence. The farmer, advised and equipped by a short-sighted educational and industrial complex, seeks refuge in chemical fertilizers and pesticides. This in turn leads to soil disorientation and pedogenic specificity. An inevitable result is a decrease in food quality, as illustrated by the fact that in 1940, wheat grown in the midwest averaged 19% protein, while in 1969 the figure was 11%. Socially, monoculture, especially in developing countries, encourages the growth of large populations dependent on 1 industry, while inhibiting the development of others. (Casey-Arizona)

W72-01762

FERTILITY STUDIES OF PASTURE SOILS IN THE WET TROPICAL COAST OF QUEENSLAND: II. GRANITIC SOILS,
Department of Primary Industries, South Johnstone (Australia). Research Station.

J. K. Teitzel, and R. C. Bruce.

Aust J Exp Agr Anim Husb. 11 (48): 77-84. 1971. Identifiers: Australia, Coast, Fertility, Granitic, Pasture, Queensland, Soils, Tropical, Wet.

Results of investigations into the fertility status of granitic soils in the wet tropical coast of Queensland are presented. The previously recognized natural infertility of these soils is confirmed with the recording of P, Cu, Zn, K, S, and Ca deficiencies. P is the most important deficiency. If this element is not applied, permanent pastures cannot be established. Cu, K, and Zn deficiencies are also very widespread.—Copyright 1971, Biological Abstracts, Inc.

W72-01767

COMPARATIVE STUDY OF NATIVE AND INTRODUCED LUCERNE VARIETIES GROWN FOR SIX YEARS IN CENTRAL NORTH BULGARIA, (IN BULGARIAN),
A. Hristov.

Rastenievod Nauki. 7 (10): 105-112. Illus. 1970. English summary.

Identifiers: Bulgaria, Comparative, Drought, Growth, Hardiness, Lucerne, Varieties, Winter, Years, Yield.

Native and selected cultivars, of Hungarian or French provenance, are distinguished by a faster pace of growth and development, and produce considerably higher yields compared with the introduced cultivars. The size of their annual yield is determined primarily by the amount and distribution of rainfall during the growing season to which they respond readily. They are also characterized by good drought hardiness, winter hardiness, durability and produce considerably higher and stable yields up to the 6th yr. The German cultivars show

more satisfactory productivity up to the 4th yr after which the yields decline. 'Ranger Brand' of American origin is well foliated, durable and productive.—Copyright 1971, Biological Abstracts, Inc.

W72-01768

WATER AND AIR CHANGES IN GRAPEFRUIT, CORN, AND COTTON LEAVES WITH MATURATION,

Department of Agriculture, Weslaco, Tex. William A. Allen, Harold W. Gausman, Arthur J. Richardson, and Ruben Cardenas.

Agron J. 63 (3): 392-394. 1971.

Identifiers: Air, Corn-M, Cotton-D, Grapefruit-D, Leaves, Maturation, Radiation, Reflectance, Spectrophotometry, Transmittance.

Many plant leaves can be simulated by a transparent plate model with rough plane-parallel surfaces. A plant leaf can be specified in this model by 2 optical parameters associated with an imaginary index of refraction and 2 parameters that represent the geometrical configuration of the internal leaf structure. The model leads to determination of water and air in a leaf by non-destructive procedures. Significant differences are observed between the measured water in a leaf and the equivalent water thickness (EWT) calculated from spectrophotometric measurements. The EWT is about 15% greater than the thickness of water than can be removed from the leaf by oven drying at 68°C for 72 hr. The motivation of such research is to facilitate interpretation of reflectance measured from aircraft or spacecraft.—Copyright 1971, Biological Abstracts, Inc.

W72-01772

SOME FACTORS RESPONSIBLE FOR VARYING EFFECTIVENESS OF STOMATAL CLOSING ANTITRANSPIRANTS,
Queensland Univ., Brisbane (Australia). Dept. of Agriculture.

Dov Pasternak, and G. L. Wilson.

Aust J Exp Agr Anim Husb. 11 (48): 48-52. Illus. 1971.

Identifiers: Acetate, Anti, Cotton-D, Maize-M, Mercuric, Peanut-D, Phenyl, Responsible, Sorghum-M, Stomatal, Tomato-D, Toxicity, Transpirants.

Experimental data are presented to explain some of the varying effectiveness of phenyl mercuric acetate (PMA) as a stomatal closing antitranspirant. In a comparison of sorghum, maize, cotton, peanuts, and tomatoes, stomatal apertures were affected to different extents by PMA sprays and environmental conditions. In addition, the relationship between aperture and stomatal resistance differed between cotton and sorghum. Thus the effectiveness of PMA depends on the balance between the degree to which stomata may be closed by prevailing conditions, the extent to which PMA can bring about further closure, and what this closure means in terms of diffusion resistance. In pot experiments with these species, PMA sprays conserved soil water, but the higher transpiration by unsprayed plants led to water deficits which soon caused stomatal closure. The balance between soil water storage, evaporative conditions, and the particular objectives of transpiration reduction would determine the value of application. Trials with sorghum, in both the field and glasshouse, showed that the effect of a single spray of PMA may be short-lived, and that successive applications may be necessary for a persistent effect. The resulting toxicity may be unacceptable.—Copyright 1971, Biological Abstracts, Inc.

W72-01774

MODIFICATION OF A 360-DEGREE ANTENNA ROTOR FOR CONTINUOUS STEPPED ROTATION,

Department of Agriculture, Urbana, Ill. E. R. Perrier, J. S. Rogers, and G. R. Stahl.

Agron J. 63 (3): 514-515. Illus 1971.

Identifiers: Antenna, Crop, Degree, Meteorology, Micro, Modification, Rotation, Rotor, Stepped.

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Conservation in Agriculture—Group 3F

An antenna rotor was modified to operate continuously stepwise automatically. The rotor was used to support a vertical profile of micrometeorological apparatus and swept a large surface area above crop rows and bare soil surfaces. The necessary modifications are easy to perform by modifying the control unit of the AC shaded-pole induction motor.—Copyright 1971, Biological Abstracts, Inc. W72-01884

CONTAMINATION WITH HELMINTH EGGS OF AGRICULTURAL PRODUCTS FROM SEWAGE-IRRIGATED FIELDS, (IN RUSSIAN), Institute of Medical Parasitology and Tropical Medicine, Moscow (USSR). For primary bibliographic entry see Field 05B. W72-01890

STUDIES ON THE IRRIGATION IN MULBERRY FIELD: I. ON THE WATER ECONOMY OF MULBERRY PLANTS UNDER DIFFERENT SOIL MOISTURE CONDITIONS (IN JAPANESE). Ministry of Agriculture and Forestry, Japan (Tokyo). Sericultural Experiment Station.

J Sericul Sci Jap. 39 (6): 443-450. Illus. 1970. English summary. Identifiers: Economy, Evapo, Field, Growth, Irrigation, Leaf, Moisture, Mulberry-D, Plants, Size, Soil, Transpiration.

Tree growth was best in the irrigation plot, next in the half-irrigation plot, and when the available water was lost (non-irrigation plot), growth entirely stopped. The increments of dry weight of plants were the greatest in the irrigation plot, next in the half-irrigation plot and least in the non-irrigation plot. Differences in soil moisture also influence the proportion of each organ of plant, that is, the proportion of leaf is distinctly large with an increase of available water. The amount of evapo-transpiration during the period from July to the end of Sept. was 6.1 mm/day in the irrigation plot, 3.2 mm/day in the half-irrigation plot and 1.2 mm/day in the non-irrigation plot, respectively. Also, the evapo-transpiration coefficient of each division was 658 in the irrigation plot, 364 in the half-irrigation plot and 276 in the non-irrigation plot. From the above-mentioned results it may be concluded: The optimum soil moisture in a mulberry field is from 50 to 100% of the available water. Under optimum soil genetic stages studied showed that the spike emergence stage is the stage to be preferred from a methodological and practical point of view.—Copyright 1971, Biological Abstracts, Inc. W72-01895

EFFECT OF TWO GROWTH-REGULATING CHEMICALS ON YIELD AND WATER USE OF THREE PERENNIAL GRASSES, Agricultural Research Service, Morgantown, W. Va. E. L. Mathias, O. L. Bennett, G. A. Jung, and P. E. Lundberg. Agron J. 63 (3): 480-483. 1971. Identifiers: Bromus-Inermis-M, Chemicals, Cycocel, Damage, Etiolation, Festuca-Elatior-M, Foliar, Grasses-M, Growth, N, Perennial, Poa-Pratensis-M, Pyrrolidino, Regulating, Succinamic-Acid, Yield.

Growth responses of smooth bromegrass (*Bromus inermis* Leyss), Kentucky-31 tall fescue (*Festuca elatior* L.), and common Kentucky bluegrass (*Poa pratensis* L.) to the growth-regulating chemicals F-529 (N-pyrrolidino-succinamic acid) and Cycocel (2-chloroethyl-trimethylammonium chloride) were studied. Growth of grasses was reduced to near zero when Cycocel was applied at a concentration of 0.584 M, with at least some retardation occurring up to 100 days after application. F-529 was less effective than Cycocel in retarding grass growth. Maximum reduction occurred at the 0.45 M concentration where growth was reduced to 35% of the control, and at 70 days following application there was no reduction. Recovery from both

chemicals was generally followed by a period of stimulated growth. Water use, in general, was highly correlated with amount of top growth. Food reserves of plants as determined by etiolated growth were significantly reduced only at the 0.292 M and 0.584 M concentration of Cycocel, where severe foliar damage had occurred.—Copyright 1971, Biological Abstracts, Inc. W72-01908

TRENDS IN PRACTICES AND PRODUCTION OF MAJOR CORN BELT CROPS,

Illinois Agricultural Experiment Station, Urbana. Agronomy Dept. J. W. Pendleton. Iowa Agric Home Econ Exp Stn Spec Rep. 64. 6-11. Illus. 1969. Identifiers: Bean-D, Control, Corn-Belt, Corn-M, Crops, Equipment, Field, Methods, Production, Reduced, Soil, Soy, Tillage, Trends, Weed.

Present midwestern agriculture is 'dynamic.' Agricultural technological improvements are quickly adapted. This has led to the dropping of crop rotations on more level land and to concentrate on the superior culture of corn and soybeans. High-quality seed are planted early in the season in narrow rows to obtain a high plant population; high fertilizer rates, reduced tillage, and herbicides for weed control are used. Harvest is done early with large equipment. These intensive agricultural practices have not resulted in the losses of topsoil from erosion or yield losses from insects and diseases but increases of some plant pathogens still occur.—Copyright 1971, Biological Abstracts, Inc. W72-01941

EFFECTS OF MINERAL FERTILIZATION IN 4 COURSE ROTATION ON SANDY SOIL: II. RESULTS OF INVESTIGATIONS IN 4TH COURSE OF ROTATION IN AN EXPERIMENT OF MANY YRS IN THE EXPERIMENT STN. MALYSZYN WIELKI, (IN POLISH), Waclaw Boguszewski, Czeslaw Mackowiak, and Walenty Mackowiak. Pamiet Pulawski, 37. 79-97. Illus. 1969. English summary. Identifiers: Barley-M, Fertilization, Lupine-D, Malyszyn, Mineral, Oats-M, Poland, Potato-D, Rotation, Rye-M, Sandy, Serradella-D, Soil, Station, Th, Wielki, Years.

The rotation consisted of: potatoes, barley, lupine, rye with undersown serradella. Increased doses of mineral fertilizers were applied. Potatoes and rye gave the most typical yields. The water deficiency often occurring in sandy soils affected their yields least. Mean yields of potatoes with and without mineral fertilizing increased by 100-110 q/ha, due to a change for the forecrop (instead of the winter aftercrop serradella undersown in rye). Rye yield in the control treatment decreased, but with fertilizing it increased. The reaction to fertilizing increased, due to the double N doses. Lupine and barley with fertilizer had lower yields than did oats. Small N doses strongly influenced the yields of all non-papilionaceous plants. The increase of the N dose affected strongly the rye yield. The P and K fertilizing caused in most cases insignificant yield increases or had no effect at all. The N balance was positive even in the treatment without mineral fertilizing, due to the cultivation of papilionaceous plants twice during the 4 yr. The P balance was in equilibrium at the fertilizing rate of 144 kg P2O5/4 yr. The K balance remained negative even at higher K doses (320 kg K2O/4yr). Mineral fertilizing did not affect the organic matter content in the soil, but it caused a slight increase of sorption capacity. P fertilizing caused an increase in P content by 1 mg P2O5/100 g of soil, while K fertilizing increased its content by 1-2 mg K2O/100 g of soil.—Copyright 1971, Biological Abstracts, Inc. W72-01944

PLANT PARASITIC NEMATODES OF FLOODED RICE FIELDS ON THE IVORY

COAST: II. ATTEMPT AT ESTIMATING THE SIZE OF POPULATIONS (IN FRENCH), Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast). Centre d'Adiopodoume. G. Merny.

Cah Orstom (Office Rech Sci Tech Outre-Mer) Ser Biol. 11. 45-67. Illus. 1970 English summary. Identifiers: Binomial, Fields, Flooded, Ivory-Coast, Law, Negative, Nematodes, Parasitic, Plant, Populations, Rice-M, Size, Taylor.

The study of the populations of some nematode species contained in 100 sampling units per hectare collected from 2 flooded rice fields in the north of the Ivory Coast showed that the populations are almost never randomly distributed. They are generally aggregated and follow the same Taylor law with an aggregation index of 1.65. Almost all the observed distributions fit the negative binomial or a similar law. A series of 10 sampling units led to a suitable mathematical estimation, for large populations. When accurate estimation is needed, especially for moderate or moderately weak populations, about 100 sampling units must be used.—Copyright 1971, Biological Abstracts, Inc. W72-01951

ASSESSMENT OF SUMMER IRRIGATED PASTURES TO SUPPLEMENT SHEEP GRAZING IRRIGATED ANNUAL PASTURES, Commonwealth Scientific and Industrial Research Organization, Deniliquin (Australia). Div. of Plant Industry.

V. R. Squires, and L. F. Myers. CSIRO (Commonw Sci Ind Res Organ) Field Sta Rec. 9 (2): 73-83. Illus. 1970. Identifiers: Annual, Assessment, Grazing, Growth, Irrigated, Lolium-Perenne-M, Merino, Paspalum-dilatatum-M, Pastures, Phalaris-Tuberosa-M, Rate, Sheep, Summer, Supplement, Trifolium-Repens-D, Trifolium-Subterraneum-D, WETHER, Wool.

Wool growth-rates from Merino wethers grazing model farms composed either wholly of irrigated annual pastures (*Trifolium subterraneum* L. and *Phalaris tuberosa* L.) or incorporating small areas of irrigated perennial pasture (*T. repens* L., *Paspalum dilatatum* Poir and *Lolium perenne* L.) were compared over a 2-yr period at 3 stocking rates: 7.8, 9.75 and 12 sheep/acre. Comparison was made of seasonal wool growth rhythms from sheep grazing either annual or perennial pastures alone or in combination. Wool cut/acre was not significantly higher from the flocks with access to green forage in summer than from those confined to annual pastures. At these stocking rates the provision of alternative summer grazing on green forage is unwaranted.—Copyright 1971, Biological Abstracts, Inc. W72-01957

EFFECTS OF NITROGEN FERTILIZER, PLANT POPULATION AND IRRIGATION ON SUGAR BEET: III. WATER CONSUMPTION, Broom's Barn Experiment Station, Bury St. Edmunds (England).

A. P. Draycott, and M. J. Durrant. J Agr Sci. 76 (2): 277-282. Illus. 1971. Identifiers: Beet-D, Consumption, England, Fertilizer, Irrigation, Nitrogen, Plant, Population, Sugar, Water.

A neutron moderation meter was used to measure soil moisture 0-4 deep in plots of sugar beet carrying 2 plant populations (8800 and 54000 plants/acre), each with and without irrigation. Recordings began in April or May in each of 3 yr (1967-69) after sowing the crop and continued at 1 or 2-wk intervals until harvest in Oct. The measured soil moisture deficits were very similar to potential deficits calculated from meteorological measurements. This indicates that the crop could extract the water needed for transpiration from the soil even when the deficits were quite large (more than 5 in 1967), which probably explains the small response to irrigation by sugar beet in England.

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation in Agriculture

When the soil moisture deficit increased rapidly early during the season (1967), the crop extracted water from the soil by exhausting the available water from progressively deeper horizons, whereas when the deficit increased rapidly late during the season (1969) water was still being extracted from all horizons until harvest. Both decreasing the plant population and irrigating decreased the amount of water used from depth in the profile every year. The total amount of water used (evaporation plus transpiration), on average, from soil reserves and rainfall, was 12.2 in by the small population and 13.4 in by the large population. When irrigated, the consumption increased to 14.2 and 15.4 in, respectively. The difference in usage between populations was almost entirely from the difference in leaf cover early during the season. The water consumption in 1968, when the summer was wet, was only two-thirds of that in 1967 and 1969 when the summers were drier.—Copyright 1971, Biological Abstracts, Inc. W72-01959

EFFECTS OF NITROGEN FERTILIZER, PLANT PRODUCTION AND IRRIGATION ON SUGAR BEET: II. NUTRIENT CONCENTRATION AND UPTAKE,
Broom's Barn Experiment Station, Bury St. Edmunds (England).
A. P. Draycott, and M. J. Durrant.
J. Agr. Sci. 76 (2): 269-275. Illus. 1971.
Identifiers: Beet-D, Concentration, Fertilizer, Irrigation, Nitrogen, Nutrient, Plant, Production, Sugar, Uptake.

The concentration of N, P, K, Na, Ca and Mg was measured in the dry matter of sugar beet from 4 field experiments (1966-69). All combinations of 4 amounts of N fertilizer (0-1.8 cwt/acre), 4 plant populations (8800-54000 plants/acre) and irrigation were tested, which gave a wide range of plant size and yield. Nutrient concentration and uptake by the crop were also greatly affected by the treatments. N fertilizer and irrigation increased uptake of N by the crop but increasing the plant population had little effect on uptake and decreased the concentration of N. Sugar yield was related to the total N concentration in tops and roots and to uptake. There were optimal values of N concentration for maximal sugar yield, but the optima were greatly affected by plant population. Leaf color was a good guide to N concentration. P concentration was affected little by the treatments but cation concentrations were greatly affected. In general, uptake of all the elements was increased by all treatments—the exception was Na, which decreased as the plant population increased but this was balanced to some extent by increased K uptake.—Copyright 1971, Biological Abstracts, Inc. W72-01960

EFFECTS OF NITROGEN FERTILIZER, PLANT POPULATION AND IRRIGATION ON SUGAR BEET: I. YIELDS,
Broom's Barn Experiment Station, Bury St. Edmunds (England).
A. P. Draycott, and D. J. Webb.
J. Agr. Sci. 76 (2): 261-267. Illus. 1971.
Identifiers: Beet-D, Fertilizer, Irrigation, Nitrogen, Plant, Population, Sugar, Yields.

Five experiments (1965-69) on calcareous sandy loam tested all combinations of 4 amounts of N (0.1.8 cwt/acre N) and 4 plant populations (8000-54000 plants/acre)— given to sugar beet grown with and without irrigation. On average, N and plant population influenced yields but irrigation relatively little. In all years between 0.6 and 1.2 cwt/acre N and between 17000 and 32000 plants/acre gave largest sugar yield. Giving more N or increasing the plant population neither increased nor decreased sugar yield much in any year. Irrigation was beneficial in only 2 out of 5 yr. Sugar yield was linearly related to root dry-matter yield. Although total dry matter was greatest when the largest plant population was given the largest dressing of N and irrigation, the proportion of dry

matter in the roots was decreased by all 3 factors.—Copyright 1971, Biological Abstracts, Inc. W72-01961

INFLUENCE OF SOIL MOISTURE ON GROWTH, YIELD AND QUALITY OF GROUNDNUT,
Indian Government Research Farm, Kanpur.
O. N. Mehrotra, R. C. Garg, and S. A. Ali.
Indian J Plant Physiol. 11 (2): 158-163. 1968.
Identifiers: Arachis-Hypogea-D, Groundnut-D, Growth, Moisture, Soil, Yield.

An experiment was conducted in pots for 2 years to evaluate the effect of different soil moisture regimes on growth, yield and quality of groundnut (*Arachis hypogea*, L.). Plants raised under half field capacity gave the best growth and yield of pods. The oil percentage increased with an increase in soil moisture, while the reverse was true for protein content. Relative turgidity of leaves increased with the increase in soil moisture.—Copyright 1971, Biological Abstracts, Inc. W72-01962

EFFECTS OF INDUCED DROUGHT ON RICE PLANTS,
Dacca Univ. (Pakistan). Dept. of Botany.
M. A. A. Khan, S. A. Hamid, and M. A. Hussain.
Pak J Biol Agri Sci. 12 (1): 1-22. Illus. 1969.
Identifiers: Drought, Grain, Plants, Rice-M, Tiller, Yield.

The drought delayed flowering time by 10 days in IR8, 23 days in Dharial, 19 days in Dular and 22 days in Marichbati. The drought induced within 3 wk after germination increased tiller formation in IR8, Dharial and Dular, late drought was harmful for tiller formation. The percentage of filled grains and 1000-grain weight were reduced severely when the drought stage approached the flowering period. The final height of plants and dry weights of straws and roots were also affected. Grain yield increased in IR8, Dharial and Dular when drought was induced within 3 wk after germination; this was primarily due to a direct result of the increase of tillers. The yield decreased in IR8 by drought between 26 and 63 days, in Dharial between 18 and 51 days, in Dular between 38 and 60 days and in Marichbati up to 64 days due to the reduction in the total and effective tillers, filled grain and 1000-grain weight.—Copyright 1971, Biological Abstracts, Inc. W72-01963

COMPARATIVE TESTING OF IRRIGATED LOCAL AND INTRODUCED DOUBLE MAIZE HYBRIDS (IN BULGARIAN),
Institute of Water Engineering and Land Improvement, Sofia (Bulgaria).
A. Raycheva-Mehandzieva.
Rastenievod Nauki. 7 (10): 27-34. 1970. English summary.
Identifiers: Comparative, Double, Hybrids, Irrigated, Local, Maize-M, Testing, Yield.

Introduced and local maize hybrids were tested on leached cinnamon forest soil at the Experiment Station for Irrigation Farming, 'Kansas 1859,' 'Ohio C92,' 'Wisconsin 641 AA,' 'VIR 42,' 'Kar nobat 1,' 'Karnobat 3,' 'No 1119,' 'K14,' 'K18,' 'P14,' 'Knezha 1,' 'Knezha 2,' 'Knezha 3,' 'Russe 4,' 'Russe 9,' 'Russe 15,' 'Russe 24,' and 'Russe 33' were tested. The tests were carried out by the block method in 4 replications, the hybrids being grouped by the length of growing season into early-4760 plants/0.10 ha and late-4080/0.10 ha. The hybrids 'Knezha 2,' 'Kansas 1859,' 'Russe 9,' and 'Russe 33' proved to be high-yielding during the test period. Nearly all Bulgarian hybrids outyield 'Wisconsin 641 AA' by 3-22% and some are earlier by 2-8 days. They may replace it on irrigated areas of leached cinnamon forest soils in regions included in the Stara Zagora irrigation system.—Copyright 1971, Biological Abstracts, Inc. W72-01965

COMPARATIVE EVALUATION OF THE IMPORTANCE OF INDIVIDUAL MEASURES IN THE TOTAL AGROTECHNICAL COMPLEX OF MAIZE IRRIGATION (IN BULGARIAN),
Institute of Water Engineering and Land Improvement, Sofia (Bulgaria).

A. Hristov, and G. Tashkov.
Rastenievod Nauki. 7 (10): 61-71. Illus. 1970.
Russian and French summaries.
Identifiers: Agrotechnical, Comparative, Complex, Individual, Irrigation, Maize-M, Measures.

Optimal conditions for maximal yield for irrigated maize are created by strict observance of the scientifically substantiated agrotechnical complex. Irrigation is of paramount importance for both the individual development and growth of plants and of the whole crop, and for ensuring high yield and maximal manifestation of the effectiveness of the other agrotechnical factors. Fertilization and stand density (within the limits of the photosynthetic optimum) rank 2nd. Timely thinning out and weed killing take the 3rd place, assuming that their importance will decline with the improvement of agricultural practices. Deep plowing ranks 4th, being of variable and dubious importance. Post-irrigation loosening of the soil is of no importance.—Copyright 1971, Biological Abstracts, Inc. W72-01966

THE EFFECT OF DIFFERENT CULTIVATION TECHNIQUES ON SOIL MOISTURE CONSERVATION AND THE ESTABLISHMENT AND YIELD OF MAIZE AT KONGWA, CENTRAL TANZANIA,
J. C. Macartney, P. N. Northwood, M. Dagg, and R. Dawson.
Trop Agr. 48 (1): 9-23. Illus. 1971.
Identifiers: Central, Conservation, Cultivation, Kongwa, Maize-M, Moisture, Mulching, Ripping, Soil, Tanzania, Techniques, Yield.

A ripping operation before the onset of the rains is an integral part of any cultivation system to provide for both water infiltration and to assist in root development on compacted soil. A case is presented for the adoption of a zonal tillage system with reduced surface cultivation, inter-row mulching and ripping.—Copyright 1971, Biological Abstracts, Inc. W72-01967

WATER USE BY MAIZE AT THREE PLANT DENSITIES,
Department of Agriculture of New South Wales, Leeton (Australia).
Lloyd A. Downey.
Exp Agr. 7 (2): 161-169. Illus. 1971.
Identifiers: Densities, Maize-M, Plants.

Water use was measured by a complete water balance, including soil moisture, rain, applied irrigation and deep drainage in crops irrigated so that relative turgidity at noon remained above 90% (i.e. no-stress conditions). Total evapotranspiration between planting and harvest, 56 cm., was not significantly affected by density, but evapotranspiration was slightly higher at higher densities when ground cover was less than 50%. Actual evapotranspiration rose to 1 cm/day during anthesis and grain filling. A 5th of the water applied moved beyond the root zone, indicating that work on more permeable soils would be inaccurate if the deep drainage component was ignored.—Copyright 1971, Biological Abstracts, Inc. W72-01968

ESTIMATING CORN CANOPY EXTREME TEMPERATURES FROM SHELTER VALUES,
Environmental Data Service, Silver Spring, Md.
James J. Rahn, and D. Murray Brown.
Agri Meteorol. 8 (2): 129-138. 1971.
Identifiers: Canopy, Corn-M, Insolation, Low, Moisture, Rainfall, Shelter, Temperatures.

Highest and lowest diurnal air and leaf temperatures in a corn canopy were compared with daily

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Conservation in Agriculture—Group 3F

maximum and minimum temperatures in a standard thermometer shelter. Differences in temperature between canopy and shelter were related to general weather parameters. The main parameters governing the canopy-shelter differences in maximum temperature were insolation and time since the last rainfall. On bright, sunny days with low moisture, warmest leaves were 10 deg F (5.6 deg C) or more above shelter maxima, while air temperatures in the canopy were as much as 4-6 deg F (2.2-3.3 deg C) above shelter values. With lower insolation and/or recent rainfall, the differences decreased. Differences in minimum temperature between canopy and shelter were primarily a function of night-time radiation conditions. With atmospheric conditions favorable for radiational cooling, air minima were 2-3 deg F (1.1-1.7 deg C) below shelter minima, while lowest leaf temperatures were 4-5 deg F (2.2-2.8 deg C) below shelter values. When atmospheric moisture was high or overcast conditions existed the differences in minimum temperature between canopy and shelter were less. Tabular methods for estimating canopy-shelter temperature differences were developed, based on categories of the estimator parameters.—Copyright 1971, Biological Abstracts, Inc.

W72-01969

INFLUENCE OF ATMOSPHERIC AND SOIL ENVIRONMENTAL PARAMETERS ON THE DIURNAL FLUCTUATIONS OF LEAF WATER STATUS OF BARLEY,

Wisconsin Univ., Madison.

A. A. Millar, R. E. Jensen, A. Bauer, and E. B. Norum.

Agri Meteorol. 8 (2): 93-105. Illus. 1971.

Identifiers: Atmospheric, Barley-M, Deficit, Diurnal, Environmental, Fluctuations, Leaf, Light, Moisture, Parameters, Pressure, Soil, Temperature, Vapor, Water.

Leaf relative water content and leaf water potential varied inversely to diurnal trends of air vapor pressure deficit, air temperature, soil surface temperature, wind velocity, pan evaporation, solar radiation, and net radiation. Leaf relative water content, leaf water potential and leaf temperatures were influenced by soil moisture content and day type. Vapor pressure deficit was negatively correlated with leaf relative water content. The correlations was -0.912 for pooled data with soil moisture near field capacity, and -0.943 for pooled data with soil moisture near the permanent wilting point. Highest correlation coefficients involving leaf water potential were obtained with soil surface temperature. The correlation was -0.862 with soil moisture near field capacity and -0.917 with soil moisture near the permanent wilting point. Leaf temperature and soil surface temperature were higher when soil moisture was near the permanent wilting point than when it was near field capacity. Leaf temperature appeared to be a sensitive indicator of plant water stress.—Copyright 1971, Biological Abstracts, Inc.

W72-01970

INFLUENCE OF PRECEDING CROPS ON THE DEVELOPMENT AND HARVEST OF CORN AND SUGAR BEETS CULTIVATED UNDER CONDITIONS OF IRRIGATION (IN BULGARIAN),

N. Kostourski.

Rastenievod Nauki. 7 (10): 35-43. Illus. 1970. Russian and French summaries.

Identifiers: Barley-M, Beets-D, Bulgaria, Corn-M, Corps, Cultivated, Development, Harvest, Irrigation, Peas-D, Sugar, Sunflower-D.

The experiment was carried out on grooved forest soil in the irrigated zone of Pazardzik (Bulgaria) and involved 7 annual antecedent crops. These crops, cultivated under excellent conditions, do not have any substantial effect on the development, growth and yield of irrigated corn. The cultivation of corn as a succeeding crop to itself and to other crops is possible. In spite of the humidity and relatively high doses of mineral fertilizer, the sugar beet yield is greatly influenced by rationally chosen ant-

ecedent crops. The best yield of root crops is obtained when they are grown after winter peas plus corn from the seeds of the 2nd crop, and barley plus 2nd crop corn, followed by sunflowers, wheat, wheat plus corn to be used for silage and corn. The poorest results are obtained when a sugar beet crop follows itself. The yield is lowered on an average from 966-1665 kg per 1/10 ha, in comparison with other antecedent crops. The sugar content of the beets is appreciably influenced by the preceding crop. When they follow grain crops, their sugar content is about 0.6-1.5% higher than that of beets following root crops. Peas have an intermediate position.—Copyright 1971, Biological Abstracts, Inc.

W72-01971

DENSITY OF IRRIGATED FODDER MAIZE GROWN AS FIRST CROP (IN BULGARIAN),

S. Dimitrov, S. Kaney, and K. Kostov.

Rastenievod Nauki. 7 (10): 81-93. Illus. 1970. Russian and English summaries.

Identifiers: Crop, Density, Fodder, Grown, Irrigated, Maize-M, St.

Seeding rates of 15, 20 and 25 kg/0.10 ha were tested at intervals of 12.5 and 25 cm, to study green mass, fodder units and digestible protein/0.10 ha. Maize sown in broad rows ensures greatest amount of dry matter. Silage produced therefrom has higher nutritive value and there is no substantial difference in the data obtained in feeding it, compared with that of maize sown at a rate of 20 kg/0.10 ha seed. Densely sown maize develops fiber and vessels to a lesser extent, as a result of which plants from these stands are tender and have higher digestibility. Irrigated fodder maize 1st crop should be planted in intervals of 12.5 cm at seeding rates of 15-20 kg/0.10 ha. The seeding rate of 25 kg/0.10 ha is not recommended since the stands lodge and mechanical harvest becomes impossible.—Copyright 1971, Biological Abstracts, Inc.

W72-01973

COMPARATIVE STUDY OF ITALIAN POLYPLOID VARIETIES OF BEETS USED IN FODDER, CULTIVATED WITHOUT IRRIGATION (IN BULGARIAN),

H. Alipour, and I. Filareto.

Rastenievod Nauki. 7 (10): 9-14. 1970. Russian and French summaries.

Identifiers: Beans-D, Beets-D, Comparative, Cultivated, Fodder, Irrigation, Italian, Oats-M, Ploid, Poly, Rotation, Varieties, Wheat-M, Winter.

Comparative studies were made on: Supernova Bianca, Supernova Rossa, Polymaster, Supernova Gigilla, Polyzena, Polyma. Yellow Eckendorf were used as a control cultivar. The experiments were carried out without irrigation, in a quadrennial crop rotation of winter wheat, beets, oats and beans, in the block method, and repeated 6 times. Each experimental lot was 20 m sq and contained 160 plants. The polyploid cultivars Supernova Bianca and Polyzena clearly outclass the diploid varieties found in Bulgaria, and should be introduced. The Vranja cultivar should be selected because of its high dry matter content. The polyploid characteristic, in combination with heterosis, may be successfully selected for in beets used in fodder and also in sugar beets.—Copyright 1971, Biological Abstracts, Inc.

W72-01974

NUTRITIVE VALUE OF FERTILIZED JARAGUA GRASS (HYPARHENIA RUFU (NEES) STAPF.) IN THE WET-DRY PACIFIC REGION OF COSTA RICA,

Florida Univ., Gainesville. Inst. of Food and Agricultural Science.

L. E. Tergas, W. G. Blue, and J. E. Moore.

Trop Agr. 48 (1): 1-8. Illus. 1971.

Identifiers: Cattle, Cellulose, Costa-Rica, Dry, Fertilized, Fertilizers, Forage, Grass-M, Hyparrhenia-Rufa-M, Intake, Jaragua, Nutritive, Pacific, Palatability, Protein, Wet.

The application of N at relatively high rates during the latter part of the rainy season increases crude protein to levels adequate for cattle. All forage must be harvested at the beginning of the dry season to retain protein and the inorganic nutrients. Jaragua grass forage quality in terms of both cellulose concentration and digestibility seemed to be relatively satisfactory throughout the dry season. However, the forage intake by cattle could be low due to the low crude protein concentration under these conditions. Deferred grazing during the dry season regardless of fertilizer rate is unsuitable. The agronomic qualities of the plant could be useful in providing roughage in dry tropical conditions if combined with protein, mineral supplements and molasses to supply nutrient requirements and to improve palatability and forage intake.—Copyright 1971, Biological Abstracts, Inc.

W72-01975

CONSUMPTIVE USE OF WATER BY COTTON IN SPRINKLER AND SURFACE IRRIGATION IN THE REGION OF THE STATE IRRIGATION SYSTEM: STARA ZAGORA, (IN BULGARIAN),

G. Hristov.

Rastenievod Nauki. 7 (10): 49-59. Illus. 1970. English summary.

Identifiers: Bulgaria, Climate, Consumptive, Cotton-D, Growth, Irrigation, Sprinkler, Stara-Zagora, Surface, System.

The mean daily water consumption by cotton grown on meadow cinnamon soils increases with the growth of plants and the onset of summer droughts. It is greatest in the period of flowering and fruit setting. The mean daily consumption for dry and wet years, and at different growth stages are given. Productivity is highest with sprinkler irrigation followed by surface irrigation.—Copyright 1971, Biological Abstracts, Inc.

W72-01977

A SYSTEM ANALYSIS OF APPLICATIONS OF EARTH ORBITAL SPACE TECHNOLOGY TO SELECTED CASES IN WATER MANAGEMENT AND AGRICULTURE-VOLUME 1, TECHNICAL SUMMARY.

Planning Research Corp., Washington, D. C.

For primary bibliographic entry see Field 07B.

W72-02029

DRYING RATES OF BIRDSFOOT TREFOIL SEED,

Vermont Univ., Burlington. Dept. of Agricultural Engineering.

E. L. Arnold, and K. E. Varney.

Vermont Agricultural Experiment Station Bulletin 666, June 1971. 24 p, 17 fig, 2 tab, 11 ref.

Descriptors: *Seeds, *Seed treatment, *Moisture content, *Drying, Analytical techniques, Testing, Weight, Evaporation.

Identifiers: *Seed storage, *Drying rates.

Birdsfoot trefoil seed, taken directly from the farmer's combine, was brought to the agricultural engineering laboratory where it was sampled for moisture content. The moisture level at which seeds can be stored satisfactorily depends on kind of seed, length of storage, temperature, and air movement. Trefoil seed was usually stored for less than 1 year. In common trade practice a moisture level of 13% to 14 percent is considered safe for storage. Changes in weight were used to measure moisture loss or gain. To measure weights, each bin was suspended on a dial-type scale; each scale was read to the nearest 0.1 pound. The drying rate of birdsfoot trefoil seed is related to the depth of the seed mass: The deeper the seed, the slower it dries. The quick drying of the first 4 inches of seed in the bottom of the bin showed that the slowness does not result from slow migration of moisture through the seed coat. Even the seed with 27% initial moisture reached moisture equilibrium in the first 4 inches in about 20 hours. (Woodard-USGS)

W72-02089

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation in Agriculture

INERTIAL FORECAST OF WATER STORAGE IN SOIL AND ITS ECONOMIC EFFECTIVENESS (INERTSIONNY PROGNOZ POCHVENNYKH VLAGOZAPASOV I YEGO EKONOMICHESKAYA EFFEKTIVNOST'),
For primary bibliographic entry see Field 02G.
W72-02095

AGROMETEOROLOGICAL CONDITIONS IN THE VOLGA REGION AND THE EFFECTIVENESS OF MEASURES TO COMBAT UNFAVORABLE HYDROMETEOROLOGICAL PHENOMENA (AGROMETEOROLOGICHESKIE USLOVIYA POVOLZH'YA I EFFEKTIVNOST'),
MEROPIRATIY PO BOR'BE S NEBLAGOPRIYATIYI NYMI GIDROMETEOROLOGICHESKIMI YAVLENIYAMI,

Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr, Leningrad (USSR).
L. A. Razumova.
Meteoroziya i Gidrologiya, No 6, p 27-36, June 1971. 4 fig, 7 ref.

Descriptors: *Meteorology, *Meteorological data, *Irrigation, *Irrigation practices, *Irrigation efficiency, Water resources, Moisture, Heat, Water consumption (Excludes consumptive use), Crop production, Crops, Wheat, Droughts, Winds, Dust storms, Frost.
Identifiers: *USSR, Volga River, Kuybyshev Oblast, Saratov Oblast, Volgograd Oblast, Astrakhan Oblast, Agrometeorology.

Agrometeorological conditions in the Volga region were described in connection with the need to utilize effectively the natural resources of the area to develop a large irrigation base for the production of marketable grains. The problems of heat and moisture supply to crops were examined against a background of adverse hydrometeorological phenomena (droughts, dry winds, dust storms, severe frost), and of the agricultural measures recommended to combat them. Three zones or irrigation efficiency, based on the moisture deficit for spring wheat grown under dryland conditions and on the increase in wheat yield resulting from application of irrigation water at optimal rates, were identified in the area of the Volga River between Kuybyshev and Astrakhan. (Josefson-USGS)
W72-02098

PROBLEMS IN THE IRRIGATION OF THE KULUNDA STEPPE (NEKOTORYYE VOPROSY OROSHENIYA KULUNDINSKOY STEP'),
Leningrad State Inst. for the Design and Planning of Water Management (USSR).
N. A. Timofeyev.
In: Kompleksnoye osvoyeniye vodnykh resursov Okskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 111-114, 1970. 1 tab.

Descriptors: *Irrigation, *Irrigation programs, *Irrigation systems, *Land reclamation, Soils, Climatic data, Groundwater, Streamflow, Runoff, Amortization.
Identifiers: *USSR, *West Siberia, Kulunda Steppe.

The Kulunda Steppe, which covers an area of 13 million ha, is located in the southern part of the West Siberian Plain in the Ob-Irtysh interfluvium and includes parts of the Altay Territory, Novosibirsk and Pavlodar Oblasts, and part of Kazakhstan. According to preliminary estimates, the cost of irrigating 1 ha of land in the area without application of reclamation practices will vary between 1.6 and 2.5 thousand rubles, and the period of amortization will average 10-15 years. Four reclamation procedures are recommended for completion prior to implementation of irrigation of the steppe and include in the order of their priority: (1) measures to combat soil wind erosion; (2) water-holding measures to retain local runoff on fields; (3) utilization of groundwater for water supply and irrigation; and (4) utilization of local runoff for water supply

and irrigation. Only upon completion of these measures will it be feasible to construct the following irrigation projects in the order indicated: (1) small irrigation systems on the Ob River; (2) the central unit of the Kulunda irrigation system; and (3) the peripheral units of the Kulunda irrigation system in the Pavlodar Oblast. (Josefson-USGS)
W72-02101

EFFECT OF WATER LOSSES FROM IRRIGATION CANALS ON GROUNDWATERS OF THE ALEYSK IRRIGATION SYSTEM (VLIYANIYE POTER' VODY IZ OROSITEL'NYKH KANALOV NA GRUNTOVYYE VODY ALEYSKOV OROSITEL'NOY SISTEMY),
K. Ya. Fesko.

In: Kompleksnoye osvoyeniye vodnykh resursov Okskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 202-208, 1970. 1 tab.

Descriptors: *Groundwater, *Water table, *Water loss, *Irrigation systems, *Irrigation canals, Irrigation practices, Irrigation water, Irrigated land, Water distribution (Applied), Salts, Salinity, Drainage, Leaching.
Identifiers: *USSR, *West Siberia, Altay Territory, Aleysk, Irrigation rates.

The Aleysk irrigation system in the Altay Territory was built in 1935-38 and covers a total area of about 11,000 hectares. As a result of large water losses from the irrigation network and use of excessive irrigation rates with extremely uneven distribution of water over the field, the level of the groundwater in the growing period rises at an average rate of 0.9 to 4 cm/day. Large irrigation canals have a direct influence on the groundwater rise to a distance of more than 300 m. In addition to possible application of vertical drainage, three agrotechnical measures are recommended to reduce and prevent groundwater rise, secondary salinization, and waterlogging of irrigated lands: (1) establishment of a strict sequence of water use; (2) organization of an efficient hydrotechnical service to control all water discharges for appropriate frequency of irrigation water application; and (3) adoption of a system to improve uniformity of water distribution over a field. (Josefson-USGS)
W72-02103

RESPONSE BY IRRIGATED GRAIN SORGHUM TO BROADCAST GYPSUM AND PHOSPHOROUS ON HEAVY CLAY SOIL,
Commonwealth Scientific and Industrial Research Organization, Deniliquin (Australia). Div. of Plant Industry.

J. C. Noble, and C. R. Kleinig.
Aust J Exp Agr Anim Hub. 11 (48): 53-58. Illus. 1971.
Identifiers: Australia, Broadcast, Clay, Grain, Gypsum, Heavy, Irrigated, Phosphorus, Soil, Sorghum-M, Yield.

In 2 successive field trials at Deniliquin, New South Wales, irrigated grain sorghum was sown at 3 rates of gypsum (0, 4,480, and 8,960 lb/acre), and 4 rates of P application (0, 25, 50, and 100 lb an acre) on Billabong clay, a brown clay common on the Riverine Plain of south-eastern Australia. There was a significant response to broadcast gypsum in terms of seedling emergence, tillering, and panicle production. Furthermore, there was a positive interaction between gypsum and P response which was clearly demonstrated by the yield of total dry matter and grain in the 1st yr. Although there was a response to P in the absence of gypsum, the more effective use of P on the gypsum treatments, particularly at the higher rates of fertilizer application, was attributed to improved soil water storage. In the 2nd yr, the residual value of applied gypsum was greater following application at 8,960 lb an acre than at 4,480 lb an acre during the previous yr. Residual P had little effect in the yr following application. Copyright 1971, Biological Abstracts, Inc.
W72-02117

A COMPARATIVE STUDY OF TWO METHODS OF APPLYING CCC ((2-CHLOROETHYL) TRIMETHYLMAMMONIUM CHLORIDE) TO WHEAT,
Sydney Univ. (Australia). Dept. of Agronomy.

L. B. Lowe, and O. G. Carter.
Aust J Exp Agr Anim Hub. 11 (48): 45-47. 1971.
Identifiers: Ammonium, Chloride, Chloroethyl-trimethyl, Comparative, Grain, Lodging, Methods, Wheat-M, Yield.

Wheat, cv. Timgallen, was grown under high fertility (225 kg N/ha) conditions and spray irrigation. CCC applied either as a powder with the seed or as a spray at jointing (5.6 kg CCC/ha) increased grain yield. The higher grain yield was a result of prevention of lodging, of a greater density of ear bearing tillers, and of more grains per ear. Spraying was more effective than banding CCC with the seed and avoided the problem associated with slower seedling growth and increased weed competition. Copyright 1971, Biological Abstracts, Inc.
W72-02118

MATHEMATICAL FOUNDATIONS FOR DESIGN: CIVIL ENGINEERING SYSTEMS,
Delaware Univ., Newark, N. J. Dept. of Civil Engineering.

For primary bibliographic entry see Field 06A.
W72-02127

IRRIGATION PLANNING 2: CHOOSING OPTIMAL ACREAGES WITHIN A SEASON,
Montana State Univ., Bozeman. Dept. of Economics and Agricultural Economics.

For primary bibliographic entry see Field 06A.
W72-02130

SECONDARY ECONOMIC EFFECTS OF IRRIGATION ON THE COLORADO HIGH PLAINS,
Colorado State Univ., Fort Collins. Dept. of Economics.
For primary bibliographic entry see Field 06B.
W72-02136

YIELD OF COTTON IN RELATION TO RAINFALL IN MADHYA PRADESH,
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Indore (India). Coll. of Agriculture.
Chokhey Singh, A. Sheshagiri, and Y. S. Kapse. J. Agr Sci. 40 (8): 678-684. Illus. 1970.
Identifiers: Cotton-D, Drainage, India, Madhya Pradesh, Rainfall, Relation, Soil, Yield.

The relation of rainfall to cotton yield for 35 yr at Indore and 43 yr at Khandwa was studied. High rainfall at the time of sowing and germination in June at Khandwa favorably influenced the yield of cotton. Higher rainfall at the time of vegetative growth in July, Aug., Sept. and Oct. adversely affected the yield at both places, with greater effects at Indore due to heavier soils and poor drainage. Copyright 1971, Biological Abstracts, Inc.
W72-02161

RESPONSE OF ALFALFA VARIETIES TO DIFFERENT WATER TABLE DEPTHS AT VARIOUS STAGES OF GROWTH,
Illinois Univ., Urbana. Dept. of Agronomy.
S. D. Rai, S. A. Miller, and C. N. H. Little. Agron J 63 (2): 331-333. Illus. 1971.
Identifiers: Alfalfa-D, Depths, Growth, *Medicago Sativa*-D.

Two cultivars of alfalfa, *Medicago sativa* L., 'Kentucky Syn. Z sub 1' and 'Narragansett' were grown in glazed tiles 90 cm deep with water tables of 15, 30, and 45 cm from the surface. When the water tables were raised immediately after the harvest, the dry matter yield was drastically reduced in both varieties. No significant yield difference was found when the treatments were applied 14 or 28 days after harvest. The highest yield was obtained when water table was held 45 cm from the surface and

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Conservation in Agriculture—Group 3F

when applied 14 or 28 days after harvest.—Copyright 1971, Biological Abstracts, Inc.
W72-02162

CALIBRATION OF THE 'ELECTRONIC T SUB 1' HUMIDOMETER FOR CEREALS: PULSES AND OLEAGINOUS SEEDS, (IN RUMANIAN), Institutul de Cercetari Pentru Cereale si Plante Tehnice, Fundulea (Rumania).

H. Slusanschi.

Inst Cercet Pentru Cereale Plante Teh Fund Ser C Amelior Genet Fiziol Technol Agr. 35: 481-489. Illus. 1967. English summary.

Identifiers: Calibration, Cereals-M, Electronic, Humidometer, Oleaginous, Pulses-D, Seeds, T-1.

The water content of seeds was determined by variation in capacitance of an electrolytic condenser and registered on a dial. Numerous samples were analyzed for the different species. The regression curve representing 2 values for each seed species was used as the basis for calibrating the dial.—Copyright 1971, Biological Abstracts, Inc.

W72-02164

SOIL WATER EXTRACTION BY N-FERTILIZED SPRING WHEAT,

Agricultural Research Service, Mandan, N. D. Soil and Water Conservation Research Div.

J. J. Bond, J. F. Power, and W. O. Willis.

Agron J. 63 (2): 280-283. 1971.

Identifiers: Extraction, Fertilized, Nitrogen, Soil, Spring, Wheat-M.

Field experiments were conducted to determine the effect of applied N on water use by continuously cropped spring wheat. Applied N increased vegetative growth and soil water extraction prior to heading. In 2 of the 3 sample years, this extraction of the soil water reserve resulted in less soil water extraction after heading by the N-fertilized crop than by nonfertilized crop. Applied N did not increase depth of soil water extraction. Overwinter recharge of soil water was inversely related to soil water content at harvest.—Copyright 1971, Biological Abstracts, Inc.

W72-02165

A SELF-WATERING SYSTEM FOR GROWING PLANTS IN POTTED SOILS,

Wisconsin Univ., Madison: Dept. of Soil Science.

S. G. Dolar, and D. R. Keeney.

Agron J. 63 (2): 334-338. 1971.

Identifiers: Avena-Sativa-M, Growing, Oats-M, Plants, Potted, Self, Soils, Watering.

A wick culture technique for growing plants in potted soils was developed. In the method described, about 50 oat (*Avena sativa* L.) seeds are sown to a pot and are grown under plant-growth room conditions for about 4 wk. Water for the plants is supplied entirely by a fiberglass wick extending from the center of the pot into a glass cylinder. The technique is especially adaptable to micronutrient element studies. It has several advantages over the ordinary pot culture techniques for growing plants. The construction materials are available and inexpensive.—Copyright 1971, Biological Abstracts, Inc.

W72-02166

RESIDUAL MINERAL N ACCUMULATION IN SOIL AND ITS UTILIZATION BY IRRIGATED CORN (*ZEA MAYS* L.),

Agricultural Experiment Station, Garden City, Kans. Soil Fertility Research.

G. M. Herron, A. F. Dreier, A. F. Flowerday, W. L. Colville, and R. A. Olson.

Agron J. 63 (2): 322-327. 1971.

Identifiers: Accumulation, Corn-M, Irrigated, Leaching, Mineral, Nitrogen, Residual, Soil, Zea-Mays-M.

Field experiments on fine textured soils measured fertilizer and mineralized soil NH₄-N and NO₃-N

accumulation in the rooting profile and the effectiveness with which this residual N was used by irrigated corn. At rates of 168 and 252 kg N/ha there were substantial N gains in the 180 cm soil profile with only limited losses apparent below that depth. Delayed fertilizer application resulted in greater crop use efficiency and more residual N than with preplant application, suggesting greater losses through leaching and gaseous evolution with the latter in early spring months when there are no crop roots for rapid absorption of N. Smaller amounts of residual N remained in soil after corn grown in 51 cm rows for 3 yr than 72 and 102 cm row widths, corresponding with the larger yields obtained and heavier N utilization with 51 cm rows. Corn grain yield was related to residual soil N when no additional fertilizer was used, the quantity from 60 cm depth being proportionately less than that in the 180 cm profile but still quite effective as indicator of yield potential from the N standpoint. Use of a nitrification inhibitor with an NH₄ carrier clearly served a useful purpose in preserving mineral N in irrigated fine textured soils to the eventual benefit of yield.—Copyright 1971, Biological Abstracts, Inc.

W72-02167

SOIL MOISTURE AS AFFECTING CERTAIN PHYSIOLOGO-BIOCHEMICAL PROCESSES IN WINTER WHEAT DURING THE AUTUMN-WINTER PERIOD, (IN RUSSIAN),

Bulgarian Academy of Sciences, Sofia. Inst. of Genetics and Selection of Plants.

G. Salcheva.

Rastenievod Nauki. 7 (1): 23-37. 1970. English summary.

Identifiers: Autumn, Biochemical, Hardiness, Moisture, Physiological processes, Soil, Wheat-M, Winter, Wintering.

Soil moisture significantly affects the amount of free and bound water and the supply of protective substances in cells. Decreased soil moisture during hardening and over-protective substances in cells. Decreased soil moisture during hardening and over-wintering stimulated the enhancement of the bound water and soluble sugars in leaves and in tillering. A higher content of bound water and soluble sugars, namely of leaves and knot of tillering, characterizes the frost resistant 'No 14' in comparison with the nonresistant 'No 159' wheat. High moisture content adversely affects both varieties. Wheat plants developing at reduced soil moisture in the autumn and winter seasons are distinguished with enhanced protein N and free amino acids and particularly proline content of the tillering knot. Increased moisture decreased the protein content. Proline synthesis in dehydrated cells results in an accumulation of sugars. An artificial enrichment in saccharose sharply increases the amount of free proline and frost-hardiness of wheat plants. One-sided accumulation of free proline in cells in the absence of more sugars does not bring about an enhanced frost-hardiness of plants. Pre-seeding N, P and K fertilization favorably affects in the autumn-winter season the content of sugar, protein and free proline of plants. The harmful effect of high soil moisture on the readiness of winter wheat for overwintering may be reduced to a great extent through mineral fertilizers.—Copyright 1971, Biological Abstracts, Inc.

W72-02168

ECOLOGICAL STUDY OF IRRIGATION METHOD OF RICE PLANT: INFLUENCE OF UNDERGROUND WATER LEVEL AND RAINFALL IN RICE GROWING SEASON ON THE GROWTH OF RICE PLANT, (IN JAPANESE),

Ministry of Agriculture and Forestry, Konosu (Japan). Central Agricultural Experiment Station.

Ichiro Tanaka.

J Cent Agr Exp Sta. 14: 117-166. Illus. 1970. English summary.

Identifiers: Ecological, Growing, Growth, Irrigation, Japan, Method, Plant, Rainfall, Rice-M, Season, Underground water.

The effect of irrigation method on rice yield depended on whether the N content of the plants was affected by variations in the underground water level and whether the rainfall amount approached the optimum content of N under the climatic conditions. However, the effects of intermittent irrigation and late flooded irrigation on the nutrient uptake and the rice yield did not depend on the plowing depth, the plant density and rice variety. When rice plants are grown with large amounts of fertilizer, regulation of the N absorption is most important in order to keep the plant healthy under variable climatic conditions. Since the mineral N in the soil is reduced by intermittent irrigation in which repeated oxidation and reduction accelerate denitrification, an irrigation system may play a significant role in stabilizing rice production. When, however, the rice plants are grown with a small amount of fertilizer, intermittent irrigation may result in decreased yield as compared to customary flooded irrigation except on the soil where harmful substances generate under flooded conditions. The emphasis on irrigation management in rice cultivation with heavy fertilization such as is commonly practiced in Japan should be on regulating the N uptake rather than on maintaining the soil fertility.—Copyright 1971, Biological Abstracts, Inc.

W72-02169

STUDIES IN WATER RELATIONS OF RICE: V. EFFECT OF VARYING WATER REGIMES ON THE GROWTH OF MAIN SHOOT IN INDICA RICE,

Calcutta Univ. (India). Coll. of Agriculture.

P. K. Sen, and D. K. Das Gupta.

Indian J Agr Sci. 40 (8): 746-755. Illus. 1970.

Identifiers: Development, Growth, Indica rice, Internode, Length, Regimes, Rice-M, Shoot.

The internodes developed in quick succession from the base to the apex, the relative growth rates increasing with a higher position of the internode on the main shoot. A linear function between the relative growth rate and the internode number was observed. Irrespective of the varieties and seasons, the final length of the internodes and the main shoot, and the grain yield/plant were minimum under deficient water supply and maximum under differential supply of water at various stages of growth, with shallow submergence only during the tillering phase. A positive correlation exists between the relative rates of stem elongation and yield, making it possible to predict yield on the basis of stem growth.—Copyright 1971, Biological Abstracts, Inc.

W72-02170

INTERCULTURE IN TRANSPLANTED RICE (*ORYZA SATIVA* L.),

Indian Agricultural Research Inst., Ranchi (India).

S. K. Roy, S. Saran, and N. C. Das.

Indian J Agr Sci. 40 (8): 697-701. 1970.

Identifiers: Culture, *Oryza*-*Stiva*-M, Rice-M, Rotary, Transplanted, Weeder.

Rotary-weeding and hand-weeding were compared. Hand-weeding was as good as inter-culturing by rotary-weeder for increasing yield. Biweekly rotary-weeding was effective and economical under rainfall conditions. The response of transplanted rice to inter-cultural treatments under satisfactory and well-distributed rainfall was negligible; under erratic and inadequate rainfall, it was significant due to variations in the weed population, which was affected by rainfall frequency. Biweekly rotary-weeding and hand-weeding gave 26.9% and 18% more yields than the control.—Copyright 1971, Biological Abstracts, Inc.

W72-02171

UPTAKE OF NITROGEN AND PHOSPHORUS BY PADDY UNDER WATER-LOGGED CONDITION,

Agriculture Coll., Kanpur (India).

A. N. Pathak, and G. N. Singh.

Agra Univ J Res Sci. 17 (3): 81-84. Illus. 1968.

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation in Agriculture

Identifiers: Nitrogen, Paddy-M, Phosphorus, Uptake.

A pot culture experiment on paddy under water-logged conditions using N and P at the rate of 0.30,60 lb/acre was laid out. The NH4-N in the soil and the standing water increased with increasing doses of N and P. The value of available P increased up to 72 days of plant growth, which also increased with the increase in the doses of N and P in the soil. The uptake of N and P by plants increased with the increase in the application of P and N respectively. The yield of paddy was highest at N30 P30 level.—Copyright 1971, Biological Abstracts, Inc. W72-02172

OSMOTIC PRESSURE IN RELATION TO THE GROWTH OF BARLEY PLANTS IN SALINE AND ALKALI SOILS,

Allahabad Univ. (India). Dept. of Chemistry.

S. G. Misra, and D. P. Sharma.

Vijnana Parishad Anusandhan Patrika. 10 (3): 131-135. 1967 (Engl. sum.).

Identifiers: Alkali, Barley-M, Growth, Osmotic, Plants, Pressure, Saline, Soils.

The growth of barley takes place up to an osmotic pressure (O.P.) of 1.02 in saline soil and 1.15 in alkali soil. If K-soils are prepared out of these soils, the respective osmotic pressures are 0.36 and 0.32. These derivative soils should produce similar growth of barley but no growth takes place in the K-soil derived from alkali soil. Thus the osmotic pressure and the nature of cation saturating the exchange-complex affect barley growth.—Copyright 1971, Biological Abstracts, Inc. W72-02173

PERFORMANCE OF MEXICAN DWARF WHEATS,

Agriculture Coll., Kanpur (India).

P. S. Bhattacharjee, and B. S. Mathur.

Indian J Genet Plant Breed. 27 (2): 264-270. 1967.

Identifiers: Dwarf, Mexican, Wheats-M, Irrigation.

The Mexican dwarf cultivars 'Sonora 64,' 'Sonora 63' and 'Lerma Roja 64' respond to higher levels of fertility and being stiff-strawed and short in stature, can withstand high winds and do not lodge. With improved technology, e.g., shallower seeding (5 cm), slightly higher seed rate, (100 kg/ha), early 1st irrigation (after 3 wk of seeding), 2 irrigations during reproductive phase and immediate harvesting after maturity, these varieties are capable of giving much higher yields.—Copyright 1971, Biological Abstracts, Inc. W72-02174

GENETIC DESTRUCTION OF YIELD BARRIERS IN CEREALS,

Indian Agricultural Research Inst., New Delhi.

M. S. Swaminathan.

Indian J Genet Plant Breed. 27 (2): 165-168. 1967.

Identifiers: Barriers, Cereals, Destruction, Genetic, Maize-M, Yield.

The produced composites are as high yielding as former hybrids. They also possess a high degree of resistance to the principal diseases and considerable tolerance to drought. As a result of the development and release of the composite varieties, it would be possible to cover the entire area of about 5 million ha under maize with high yielding hybrids and varieties within a few years.—Copyright 1971, Biological Abstracts, Inc. W72-02175

EFFECTS OF LEAF ORIENTATION ON LEAF RESISTANCE TO WATER VAPOR DIFFUSION IN SOYBEAN (GLYCINE MAX L. MERR) LEAVES,

Guelph Univ. (Ontario). Dept. of Crop Science.

K. R. Stevenson, and R. H. Shaw.

Agron J. 63 (2): 327-329. 1971.

Identifiers: Bean-D, Diffusion, Glycine-Max-D, Leaf, Leaves, Orientation, Resistance, Soy, Temperature, Vapor.

Soybeans (G. max L. Merr) were grown in 75-liter potometers within an area that could be covered by a movable shed during rainfall periods. Leaves on 3 of 10 plants in each potometer were tied upright, while leaves on the other plants were left naturally exposed. Two soil moisture levels were used. The leaf resistance values for upright leaves were less than those of naturally exposed leaves on 8 of the 9 sunny days and averaged 1.38 sec/cm less. Similarly, leaf temperature were less for upright leaves. On overcast days, leaf orientation had no effect on leaf resistances or temperatures. These differences were measured on individual plants and not on whole canopies. The data suggests, however, that less leaf resistance to water vapor diffusion and lower temperatures of leaves would occur in soybean canopies with upright leaves and that this characteristic could be a worthwhile objective in breeding soybean varieties with tolerance to moisture stress.—Copyright 1971, Biological Abstracts, Inc. W72-02176

RAPID FIELD MEASUREMENT OF LEAF WATER POTENTIAL IN SOYBEAN,

Pahlavi Univ., Shiraz (Iran). Dept. of Crop Science.

J. S. Boyer, and S. R. Ghorashi.

Agron J. 63 (2): 344-345. Illus. 1971.

Identifiers: Bean-D, Field, Glycine-Max-D, Leaf, Measurement, Potential, Soy.

Leaf water potentials of soybeans (Glycine max L. Merr.) were compared by 2 methods, the pressure chamber and the thermocouple psychrometer. A correlation coefficient of 0.957 was found for the 2 methods at leaf water potentials ranging from -3 to -25 bars. The pressure chamber method was used to measure the leaf water potential of several hundred soybean plants in different cultural studies in 1969 at Urbana, Illinois and found to be a rapid, efficient method.—Copyright 1971, Biological Abstracts, Inc. W72-02177

ENERGY AND CO₂ BALANCE OF AN IRRIGATED SUGAR BEET (BETA VULGARIS) FIELD IN THE GREAT PLAINS,

Texas A & M Univ., College Station. Dept. of Soil and Crop Science.

K. W. Brown, and Norman J. Rosenberg.

Agron J. 63 (2): 207-213. 1971.

Identifiers: Balance, Beet-D, Beta-Vulgaris-D, Carbon, Energy, Field, Great, Irrigated, Oxide, Plains, Resistance, Stomatal, Sugar.

The fluxes of latent heat and CO₂ above an irrigated sugar beet (B. vulgaris) field in the North Platte Valley of Nebraska were calculated by means of the energy balance. The advection of sensible heat to the field was large only when strong dry winds predominated or when the field acted as a leading edge of the irrigated river valley. There was little evidence of midday depression in sugar beet photosynthetic rate. Contrary to reported aerodynamic evaluations of CO₂ flux in the field, the energy balance calculations do not reveal a relationship between wind speed and CO₂ flux, except for a negative correlation during a dry windy period. This decrease was attributed to increased stomatal resistance. The crop appeared to be light-saturated at 0.8 cal cm⁻² min⁻¹ short wave radiation. When CO₂ flux is corrected for soil CO₂ emission and plant respiration, agreement with plant sampling measurements of dry matter increase is good. Water use ranged from 171 g per g dry matter fixed on a cloudy day to an average of 365 g per g dry matter fixed on clear days. Since the sugar beet crop is saturated at less than full sunlight, water use is greater than is necessary for the production obtained.—Copyright 1971, Biological Abstracts, Inc. W72-02178

CHANGES IN THE RATIO BETWEEN SUGAR BEET EVAPOTRANSPIRATION AND PAN EVAPORATION DURING THE GROWING SEASON,

Hebrew Univ., Rehovoth (Israel). Faculty of Agriculture.

B. Gornat, D. Goldberg, and D. Sadan.

Agron J. 63 (2): 256-258. 1971.

Identifiers: Beet-D, Evapo, Evaporation, Growing, Irrigation, Pan, Ratio, Season, Sugar, Transpiration.

Evapotranspiration by sugar beets and evaporation from a Class A pan were measured at 4- and 6-day intervals during the period Nov-May. Plant development and the progressive coverage of the ground by foliage were also followed. The ratio between evapotranspiration and evaporation, which might be used as an indicator of how much irrigation water to apply, changed during the course of the growing season. This change was independent of plant development or ground cover, but was related to evaporative conditions, and even more so to the moisture content of the upper soil layer. The effect of these 2 factors on the change in the ratio was linear.—Copyright 1971, Biological Abstracts, Inc. W72-02179

PERENNIAL IRRIGATED PASTURES: I. PLANT, SOIL WATER, AND ANIMAL RESPONSES UNDER ROTATIONAL AND CONTINUOUS GRAZING,

California Univ., Davis. Dept. of Water Science.

C. A. Raguse, D. W. Henderson, and J. L. Hull.

Agron J. 63 (2): 306-308. 1971.

Identifiers: Animal, Clover-D, Dactylis-Glomerata, Grass-M, Grazing, Irrigated, Ladino, Lolium, Perenne-M, Orchard, Pastures, Perennial, Plant, Rotational, Rye, Soil, Strawberry, Trifolium-Fragiferum-D, Trifolium-Repens-D.

Continuous grazing favored strawberry clover (Trifolium fragiferum L. 'Salina'), and rotational grazing (5-field; 1-wk grazing, 4-wk recovery) favored Ladino clover (T. repens L.) in a sward containing Ladino clover, 'Salina' strawberry clover, orchard-grass (Dactylis glomerata L.), and perennial ryegrass (Lolium perenne L.). A 2-field rotation (1-wk, 1-wk) favored strawberry clover but had less influence on botanical composition than either 5-field rotation or continuous grazing. Continuous grazing resulted in a higher percentage of plant cover than did 5-field rotational grazing. Yields of beef per unit area were similar under the 3 systems. Water infiltration increased progressively during the 4 yr of the experiment, and final infiltration rates were 2-3 cm/hr in both continuous and rotationally grazed pastures.—Copyright 1971, Biological Abstracts, Inc. W72-02180

RANGE RESOURCES OF ICELAND,

Agricultural Research Inst., Reykjavik (Iceland).

I. Thorsteinsson, G. Olafsson, and G. M. Van Dyne.

24 (2): 86-93. Illus. Map. 1971.

Identifiers: Horse, Iceland, Range, Resources, Sheep.

Animal agriculture in Iceland is second only to fisheries. At least half the forage consumed by large herbivorous animals comes from rangelands. During the period June-Sept. most of the sheep and large numbers of unbroken horses graze on mountain ranges where they roam freely in large grazing districts or commons. There is urgent need for land reclamation and range improvement. Only 25% of the country is covered with vegetation, much of which does not provide adequate protection against soil erosion and has low carrying capacity. With increasing population and demands upon rangelands for food production, an aggressive program of rangeland improvement and management, supported by adequate research, is essential.—Copyright 1971, Biological Abstracts, Inc. W72-02181

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Conservation in Agriculture—Group 3F

A HYDROSTATIC LYSIMETER TO MEASURE EVAPOTRANSPIRATION UNDER REMOTE FIELD CONDITIONS,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 02 D.
W72-02187

SOUTH AFRICA AND ITS WATER PROBLEM (L'AFRIQUE DU SUD ET LE PROBLEME DE L'EAU),
For primary bibliographic entry see Field 04 A.
W72-02209

A CRITIQUE OF THE CONCEPT OF GROWING SEASON,
Hawaii Univ., Honolulu. Dept. of Geography.
Jen-hu Chang.
Professional Geographer, Vol 23, No 4, p 337-340, October 1971. 1 fig, 2 tab, 8 ref.

Descriptors: *Tropical regions, *Solar radiation, *Crop production, *Photosynthesis, *Moisture stress, Trees, Ecological distribution, Biomass, Evapotranspiration, Water balance, Leaves, Climatic data, Temperature.
Identifiers: *Growing season, *Potential evapotranspiration, *Water use efficiency.

The growing season length of any given region is defined as the number of consecutive frost-free days per year. Agricultural potential has been assumed directly proportional to growing season, and it is through this reasoning that many people have concluded that the frost-free tropics with their luxuriance of natural vegetation, are areas of great agricultural potential. It is argued that this conclusion is false and arose as a result of a number of fallacious assumptions. The concept of growing season makes no reference to any particular crop, and many crops of high economic value have practically no growing season in the tropics. There are 2 essential physical and physiological differences between perennial trees and annual herbaceous crops: (1) agriculture attempts to achieve a high ratio between net photosynthesis and standing crop biomass while natural strategies are directed toward a reverse efficiency; (2) leaf geometry of herbaceous crops results in a lower efficiency of sunlight utilization than that of stratified tree canopies. A review of average annual solar radiation in tropical and temperate areas reveals that temperature regions receive 100-150 langleys/year more than tropical regions. Plant growth is strongly dependent on day length, which increases with latitude during summer months. Finally, many tropical regions have a low double cropping index because of greater drought periods than previously estimated and because crop water use efficiencies are much lower. (Casey-Arizona)
W72-02211

SEASONAL EFFECTS ON SOIL DRYING AFTER IRRIGATION,
Agricultural Research Service, Phoenix, Ariz.
Water Conservation Lab.
For primary bibliographic entry see Field 02 D.
W72-02217

MULCHING TECHNIQUES FOR ARID LANDS VEGETABLE PRODUCTION,
Arizona Univ., Tucson. Dept. of Horticulture.
R. W. Peebles, and N. F. Oebker.
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 133-142, 1971. 4 tab, 4 ref.

Descriptors: *Mulching, *Horticultural crops, *Evaporation control, *Crop response, *Arid lands, Arizona, Rainfall, Water conservation, Soil management, Soil surfaces, Water management (Applied), Plastics, Gravels, Soil temperature, Vegetable crops.

Mulches have been used for evaporation suppression in facilitating vegetable production under arid lands conditions. A study was undertaken in order to evaluate the effectiveness of plastic aprons, supplied by the FAO, as compared to gravel mulches. The vinyl aprons were 6 mils thick and about 1 meter square. Squash plants (*Cucurbita pepo*) were planted with gravel or plastic aprons or in bare areas and under different watering schedules. The yields under plastic aprons were considerably greater than under gravel and required slightly less water. Bare soil yields lagged far behind. Soil temperatures under the plastic aprons were consistently higher over 24 hours than bare soil, which within limits, would facilitate faster crop growth. Additionally, the apron collects and diverts rainfall to the plant. The vinyl used lasts only 2 seasons, and gravel would probably be a more suitable mulch for developing countries where capital is scarce. (See also W72-02212) (Casey-Arizona)
W72-02221

OPTIMAL UTILIZATION OF PLAYA LAKE WATER IN IRRIGATION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

M. J. Dvoracek, and T. G. Roefs.
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 301-312, 1971. 10 ref.

Descriptors: *Playas, *Water sources, *Dynamic programming, *Stochastic processes, *Rainfall, Irrigation water, Semiarid climates, Model studies, Mathematical models, Crop response, Timing, Probability.

Playa lakes usually occur in arid or semiarid regions where lands are flat and there is an absence of well-developed surface drainage nets. They are usually filled by surface runoff from highly erratic precipitation patterns. There are about 20,000 of them in the high plains of Texas and their volume of storage is an estimated 2.5-3 maf. As such, they represent a major underutilized water source. The major drawbacks to their utilization are high evaporation losses, questionable depth-area relations and the stochastic nature of the rainfall source. This paper assumes that the water is available and presents a dynamic programming model useful in determining the optimal utilization of the water for irrigation. If irrigation is the major use, its timing of application is of paramount importance. A deterministic dynamic programming model, utilizing the state variables of antecedent soil moisture and amount of available water, is presented, and provides the time and amount of irrigation required to maximize crop response. A better stochastic model is also presented which considers rainfall probability and resulting lake filling. The models are only first attempts and do not incorporate all possible variables. (See also W72-02212) (Casey-Arizona)
W72-02231

USE AND ABUSE OF SOUTHWESTERN RIVERS. THE PUEBLO DWELLER,
American Foundation, Inc., Dragoon, Ariz.
C. C. DiPeso.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 381-385. 6 ref.

Descriptors: *History, *Arid lands, *Water resources development, *Irrigation systems, *Soil conservation, Irrigation practices, Rainfall, Modes of action, Dendritic, River basins, Valleys, Exploitation.
Identifiers: *Pre-Columbian technology.

In response to the 20th century crisis of environmental destruction by unrestricted technological exploitation, some archaeologists are studying al-

ternative modes of resource development as practiced by earlier men. The Pueblo Indians of the arid southwestern deserts were basically upland corn farmers, who, after A.D. 1000, found it necessary to exploit their environment because of varying combinations of climatic change and increased population pressures. In the northeastern part of the state of Chihuahua, urban engineers, ca 1050, harnessed the entire Casas Grandes dendritic pattern by installing a set of linked hydraulic appointments which included various uplope protective devices such as linear border, check dams and riverside and hillside terraces. Not only were they able to visualize an entire dendritic pattern as the target area, but also they were able to conceive of rainfall and topsoil as a single factor in their control designs. Although large amounts of human labor were needed to construct and maintain these systems, few raw materials were needed. When the mountain-born waters reached the lower valleys, they were clear and sluggish, did not flood the bottomlands, and because of the reduced speed, could easily be diverted into canals and reservoirs, supplying the cities with domestic water and the farmers with irrigation water. Many further studies are needed of these pre-Columbian systems. (See also W72-02212) (Casey-Arizona)
W72-02236

USE AND ABUSE OF SOUTHWESTERN RIVERS. HISTORIC MAN—THE SPANIARD,
Southwestern Mission Research Center, Tucson, Ariz.
For primary bibliographic entry see Field 04 A.
W72-02237

THE INFLUENCE OF BUSH VELD TREES ON THE PRODUCTIVITY OF PANICUM-MAXIMUM-M: A PRELIMINARY REPORT,
O. J. H. Bosch, and J. J. P. Van Wyk.
Proc Grassl Soc S Afr. 5: 1970. 69-74.

Identifiers: *Acacia-Senegal*-D, *Acacia-Tortilis*-D, *Boscia-Albitrunca*-D, Bush, *Combretum-Apicalatum*-D, Light, Moisture, *Panicum-Maximum*-M, Productivity, Shading, Soil, Trees, Veld.
W72-02239

TROPICAL PRODUCTION OF VEGETABLE CROPS,
J. E. Knott.
Hortscience. 6 (1 Sec 1): 1971. 22-23.
Identifiers: *FIERS*Cabbage-D, *Cajanus-Cajan*-D, *Carrot*-D, *Cauliflower*-D, Crops, Fungicide, Humidity, Insecticide, *Pachyrhizus-Erosus*-D, *Potato*-D, Production, Rain, *Sechium-Edule*-D, Storm, Temperature, *Tetragonolobus-Purpureus*-D, Tropical, Vegetable.
W72-02241

USE OF CONTROLLED ENVIRONMENT FOR VEGETABLE PRODUCTION IN DESERT REGIONS OF THE WORLD,
M. H. Jensen, and M. A. Teran.
Hortscience. 6 (1 Sec 1): 1971. 33-36.

Identifiers: Controlled, Copper, Desert, Disease, Environment, Insect, Insecticide, Irrigation, Malathion, Nutrient, Planting, Production, Ripening, Solution, Sulfate, Temperature, Vegetable, World.
W72-02243

THE EFFECTS OF COBALT AND COPPER TREATMENT ON THE WEIGHT GAINS AND BLOOD CONSTITUENTS OF CATTLE IN KENYA,
D. A. Howard.

Vet Rec. 87 (25): 1970. 771-774.
Identifiers: Blood, Cattle, Cobalt, Constituents, Copper, Growth, Injections, Kenya, Pasture, Pellets, Rain, Treatment, Weight.
W72-02244

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation in Agriculture

DRYLAND AGRICULTURE IN CALIFORNIA GRAIN CROPPING WITH WINTER RAINFALL, R. E. Luebs.

Calif Agr. 24 (12): 1970. 12-13.

Identifiers: Agriculture, Barley-M, California, Cropping, Dryland, Fertilizer, Grain, Nitrogen, Rainfall, Winter, Yield.

W72-02245

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

MOVEMENT AND ADSORPTION OF PESTI- CIDES IN STERILIZED SOIL COLUMNS, Florida Univ., Gainesville. Water Resources Research Center.

For primary bibliographic entry see Field 05B.

W72-01697

ENHANCEMENT OF ECOLOGIC AND AESTHETIC VALUES OF WATER AS- SOCIATED WITH INTERSTATE HIGHWAYS, Massachusetts Univ., Amherst.

For primary bibliographic entry see Field 04C.

W72-01698

HYDROLOGIC CHARACTERIZATION OF FORESTED WATERSHEDS IN ARIZONA, Arizona Univ., Tucson.

For primary bibliographic entry see Field 02C.

W72-01702

PUMPED STORAGE: STATE-OF-THE-ART. For primary bibliographic entry see Field 08C.

W72-01771

MODEL FOR FLOW AUGMENTATION ANAL- YSIS-AN OVERVIEW,

Camp, Dresser and McKee, Boston, Mass.

For primary bibliographic entry see Field 05G.

W72-01874

LOW COST STORM DRAINAGE WITH PAVED CHANNELS,

Director of Public Works, Rockford, Ill.

C. Wendell, and R. E. Emmons.

Public Works, Vol 101, No. 4, p 110-111, April, 1970, 3 fig.

Descriptors: *Storm drains, *Channel improvement, Drainage patterns, Surface drainage, Concrete, Economics, Land reclamation, Parks, Costs, Illinois, Cities, Urbanization.

Identifiers: *Paved channels, Streets, *Urban drainage, *Rockford (Ill).

Major community public works improvements for storm water removal are often limited by available funds. Rockford, Illinois solved a problem of this type by the use of open paved drainage channels instead of the conventional storm sewers. This engineering approach saved the city nearly 45% of the estimated cost for the project and more important permitted the initiation of this important improvement. The area in question was considered by many as being nearly as 160 acre swamp not fit to preserve. Two previous bond issues to obtain funds for this project were not approved by the citizens. The low cost, open, paved channel approach finally won approval and the necessary funds were obtained. The total cost of the system was less than \$4 million. The result has been a realization of the full potential of the area, parks have been built, streets paved, residential areas expanded and mosquito breeding places eliminated. Growing cities like Rockford, Illinois are continually faced with dwin-

dling resources for needed public improvements. One possible way to save money, increase services and provide adequate, well-designed storm drainage systems is the utilization of paved, open drainage channels. (Goessling-Texas) W72-01880

NONIRRIGATED CULTIVATION OF PERSIAN WALNUT UNDER THE CONDITIONS OF KISLOVODSK (IN RUSSIAN),

E. M. Khrichenko.

Tr. Azerb Nauch-Issled Inst Les Khoz Agrolesomelior. 7: 142-145. 1967.

Identifiers: Apple-D, Apricot-D, Cherry-D, Cultivation, Kislovodsk, Nonirrigated, Persian, Plum-D, Preparation, Soil, Spacing, Walnut-D.

Persian walnut cultures in the vicinity of Kislovodsk are sited between 1,000 and 1,300 m above sea level. On gentle slopes (up to 10 deg) soil is prepared by contour plowing a bare fallow followed by repeated harrowings. On 10-45 deg slopes the land is terraced in strips 3.5-3.7 m wide and a total length of 850-900 m/ha of slope. Walnut cultures are planted in a mixture with other fruit trees (cherry, plum, apricot, apple, etc.) using a 5 x 3 m spacing of the main tree species in open areas and every 1-2 m in a row on terraces (or 667 and 2,100-2,500 trees per hectare, respectively). Tending consists of interrow cultivation and hand hoeing for 2-3 yr. Best results are obtained from spring plantings and on northern slopes. On southern slopes, walnut will only grow under the protection of other tree species.—Copyright 1971, Biological Abstracts, Inc.

W72-01893

CHARACTERS OF FORMATION OF FOREST SHELTERBELTS OF VARIOUS COMPOSITION AND METHODS OF THEIR ESTABLISHMENT (IN RUSSIAN),

A. A. Lishenko.

Tr. Azerb Nauch-Issled Inst Les Khoz Agrolesomelior. 7: 100-107. 1967.

Identifiers: Birch-D, Black, Characters, Composition, Forest, Formation, Locust-D, Methods, Oak-D, Pedunculate, Poplar-D, Shelterbelts, Ulmus-Pinnato-Ramosa-D, Walnut-D.

In the Ukraine, pedunculate oak, black locust, poplar, birch, black and Persian walnut, Ulmus pinnato-ramosa are used as the principal species in the field shelterbelts. Strips of these species differ considerably as to the time and character of the formation of the structure of the belts. Growth and formation of oak in the strips proceed comparatively slowly. Depending on the site conditions, oak plantations, with the normal agrotechniques of establishment and cultivation, attain the height of 3.5-6 m and close their canopy completely by the end of the 1st or the beginning of the 2nd 10-yr period. In the field shelterbelts, where oak was introduced by the planting of seedlings, the wind-permeable structure is achieved by a single improvement cutting. With a denser original spacing, the difficulty of forming strips of wind-permeable structure increases. Uniform row plantings of oak with seedlings are more efficient in the southern steppe than the introduction of oak by line and line-seedspot sowing and nest sowing. In the field shelterbelts consisting of fast growing principal species (poplar, birch, black and Persian walnut, black locust), the formation of wind-permeable structure takes place faster than in oak plantation.—Copyright 1971, Biological Abstracts, Inc.

W72-01897

CERTAIN RESULTS OF AFFORESTATION UNDER THE 'BOGARA' (UNIRRIGATED LAND) CONDITIONS OF THE AZERBAIDZ- JAN SSR (IN RUSSIAN).

Tr. Azerb Nauch-Issled Inst Les Khoz Agrolesomelior. 7: 8-19. 1967.

Identifiers: Af, Azerbaijan-SSR, Bogara, Exposure, Forestation, Juglans-Regia-D, Land, Plant,

Quercus-Castaneifolia-D, Slope, Spacing, Under, Unirrigated, USSR.

In mountainous regions the growth and development of tree species in forest plantings are conditioned by several factors, among which are the exposure and the steepness of slopes, the soil preparation method and the spacing of plants. Juglans regia growing on the northern and northeastern slopes began fruiting at the age of 8 yr; the canopy of the plantings closed and thus performs the ameliorative functions very well. On the southwestern and southern expositions, walnut does not bear fruit at the age of 11 yr and the canopy of the plantings is not yet closed. The spacings provide for the ameliorative functions under mountain conditions, walnut should be planted more sparsely on the southern slopes. On the northern slopes, walnut develops more slowly; denser planting is recommended. Data are given of the results of raising Quercus castaneifolia by means of the group sowing method with a spacing of 5 x 3 m.—Copyright 1971, Biological Abstracts, Inc.

W72-01898

ESTABLISHMENT OF ANTI-EROSION PLAN- TATIONS IN THE MOUNTAIN REGIONS OF TADZHIKISTAN (IN RUSSIAN),

V. I. Zapryagaeva.

Tr. Azerb Nauch-Issled Inst Les Khoz Agrolesomelior. 7: 50-53. 1967.

Identifiers: Almond-D, Anti, Apple-D, Drought, Erosion, Mountain, Pear-D, Pistachio-D, Plantations, Resistance, Tadzhikistan, USSR, Walnut-D.

Walnut, pistachio, almond apple, and pear are well adapted to drought conditions. Under natural conditions, the trees have many stems, are shrub-like, possess good and deep crowns capable of giving an abundant fruit crop. Pistachio, a very drought-resistant tree, is capable of growing and fruiting under conditions under which no other woody plant would survive. The main problems of the reclamation of mountain 'bogara' (unirrigated) areas with nut tree anti-erosion plantings are discussed.—Copyright 1971, Biological Abstracts, Inc.

W72-01899

INTERRELATIONS BETWEEN TREE SPECIES IN FOREST BELTS ON UNIRRIGATED LANDS (IN RUSSIAN),

A. X. Bukov, and K. G. Nagiev.

Tr. Azerb Nauch-Issled Inst Les Khoz Agrolesomelior. 7: 134-138. 1967.

Identifiers: Acer-Negundo-D, Alibia-Julibrissin-D, Belts, Catalpa-D, Cotinus-Coggyria-D, Cupressus-Lusitanica-G, Cydonia-D, Cypress-G, Ficus-Carica-Hyrcanica-D, Forest, Fraxinus-Pennsylvanica-Lanceolata-G, Gleditsia-Triacanthos-D, Inter, Kobia-Pseudoacacia-D, Lands, Mexican, Morus-D, Pear-D, Pinus-Nigra-Caramanica-G, Plum-D, Prunus-Cerasifera-Divaricata-D, Quercus-Castaneofolia-D, Quillaja-Saponaria-D, Quince-D, Relations, Species, Thuja-Orientalis-G, Tree, Unirrigated.

In Ordzhonikidze, forest belts consisted of Robinia pseudoacacia, Gleditsia triacanthos, Acer negundo, Morus, Fraxinus pennsylvanica lanceolata, Quillaja saponaria, and Cotinus coggyria. In Kirov the tree species in the forest belts included Quercus castaneofolia, Cupressus lusitanica, Prunus cerasifera divaricata, common Catalpa, Cydonia, Alibia julibrissin, Pinus nigra caramanica, Thuja orientalis, Ficus carica hyrcanica. In the Aurora State Farm, it was Mexican cypress, plum, pear and quince. The interrelations of the species are analyzed as spacing (between trees) and the types of mixed stands.—Copyright 1971, Biological Abstracts, Inc.

W72-01900

SOME NECESSARY MEASURES IN UNIRRIGATED AFFORESTATION IN THE ARMENI- AN SSR (IN RUSSIAN),

G. M. Akhinyan.

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Control of Water on the Surface—Group 4A

Tr Azerb Nauch-Issled Inst Les Khoz Agrolesomelior. 7: 54-60. 1967.
Identifiers: Af, Armenian-SSR, Conservation, Forestation, Measures, Moisture, Size, Slope, Trench, Unirrigated, USSR.

Successful reforestation depends on soil preparation methods, the shape of trenches, terraces and ditches capable of accumulating and conserving the maximum possible amount of moisture. On comparatively gentle slopes (up to 20 deg), where surface run-off is comparatively small, narrow trenches (40 x 35 x 35 cm) or double plow-furrows may be used; where conditions are severe, trenches of greater capacity (35 x 50 x 75 cm) which retain the entire surface run-off and accumulate a considerable amount of water are recommended. On slopes with 30-40 deg steepness, provided the soil is sufficiently permeable, trenches may be smaller (35 x 35 x 35 cm). The problems are discussed of rational selection of tree species, schedules for tree and shrub mixtures, distances between trenches, and density in the trenches.—Copyright 1971, Biological Abstracts, Inc.

W72-01901

PECULIARITIES OF PROTECTIVE AFFORESTATION ON THE 'BOGARA' (UNIRRIGATED LANDS) OF UZBEKISTAN, (IN RUSSIAN), N. P. Boiko.

Tr Azerb Nauch-Issled Inst Les Khoz Agrolesomelior. 7: 118-130. 1967.
Identifiers: Acer-Semenovii-D, Af, Amygdalus-Bucharica-D, Apricot-D, Bogara, Cotinus-Coggyria-D, Elaeagnus-Angustifolia-D, Elaeagnus-Edulis-D, Forestation, Fraxinus-Pennsylvanica-D, Fraxinus-Syriaca-D, Gleditsia-D, Growth, Lands, Lonicera-Tatarica-D, Malus-Sieversii-D, Pear-D, Peculiarities, Pistacia-D, Protective, Robinia-Pseudacacia-D, Ulmus-Pinnato-Ramosa-D, Unirrigated, USSR, Uzbekistan.

The shrubs Lonicera tatarica, Elaeagnus angustifolia, Cotinus coggyria, Pistacia and Amygdalus bucharica are planted in the outer rows to give the strips the required structure, but not for soil-protecting purposes. For shelterbelts the following principal species are used: Robinia pseudoacacia, Ulmus pinnato-ramosa, Gleditsia and Fraxinus pennsylvanica; associate species include Acer semenovii, Fraxinus syriaca, apricot, common pear, Elaeagnus edulis and Malus sieversii. Recommendations as to agrotechniques of establishment and management, data on water reserves in the soil under different tree species at the beginning and the end of the growing season, the results of the experiments on the persistence of height increment, tree growth in relation to the method of soil preparation, and data on the increase of grain yield under the effect of protecting forest strips are given.—Copyright 1971, Biological Abstracts, Inc.

W72-01902

STRIP AFFORESTATION ON DISTANT PASTURES OF THE WESTERN KAZAKHSTAN, V. A. Neofitov.

Tr Azerb Nauch-Issled Inst Les Khoz Agrolesomelior. 7: 131-133. 1967.
Identifiers: Af, Belts, Elaeagnus-Angustifolia-D, Forestation, Growth, Kazakhstan, Pastures, Productivity, Shelter, Strip, Ulmus-Pumila-D, USSR, Western.

Evaporation of a free water surface is reduced in the sheltered zone by 12-18% in comparison with the control, and the temperature of surface soil layers under the canopy of plantations is reduced by 11-14 deg. In the sheltered zone the growing season is extended by 12-15 days on the average and even more in individual species. Productivity of natural pastures is increased by 5-100%. The belts are arranged at a right angle to the direction of the prevailing snow-storms with Russian olive (Elaeagnus angustifolia) and Siberian elm (Ulmus pumila) as the main tree species.—Copyright 1971, Biological Abstracts, Inc.

W72-01903

MULTIRESERVOIR ANALYSIS TECHNIQUES IN WATER QUANTITY STUDIES, Saskatchewan-Nelson Basin Board, Regina.

J. A. Kerr.

Paper presented at Seventh American Water Resources Conference, October 28, 1971, Washington, DC. 15 p, 8 fig, 21 ref.

Identifiers: *Reservoirs, *Hydrology, *Hydraulics, *Water yield, *Systems analysis, Computer programs, Analytical techniques, Mathematical studies, Mass curves, Model studies, Water storage.

Identifiers: *Multireservoir analysis, *Water quantity, Canada.

Different types of systems analysis tools were applied to water quantity studies of multireservoir networks to determine how each tool can be used, modified and combined with other tools to solve specific problems. Mass curve analysis was extended to serve in computing reservoir rules for conventional multireservoir simulation models. Extended and limiting features of conventional time-interval-by-time-interval multireservoir simulation models were analyzed, and a two-model series for more difficult problems is described. The importance of efficient computer procedures is stressed. The background for the paper includes systems analysis of water availability and hydrothermal power studies carried out during the past 6 years in that part of Canada lying between Lakes and the Rocky Mountain Divide. (Woodard-USGS)

W72-02057

COMPLEX-USE MANAGEMENT OF WATER RESOURCES OF THE OB RIVER BASIN (KOMPЛЕКСНОЕ ОСВОЕНИЕ ВОДНЫХ РЕСУРСОВ ОБСКОГО БАССЕЙНА), Institut Gidrodinamiki, Novosibirsk (USSR).

Izdatel'stvo 'Nauka', Novosibirsk USSR, 1970. 256 p.

Identifiers: *Water resources, *Water resources development, *Water management (Applied), *Administration, *Feasibility studies, Project feasibility, Future planning (Projected), Long-term planning, Construction, Natural resources, Hydroelectric power, Water balance, Water demand, Water requirements, Water utilization, Water pollution, Irrigation, Hydrogeology, Groundwater.

Identifiers: Streamflow, *USSR, *West Siberia, Kazakhstan, Ob River, Irtysh River, Kulunda Steepe, Water power.

This is a collection of 35 papers prepared on the basis of a number of reports presented at the Second Conference on the Complex-Use Management of the Ob River basin, held in Novosibirsk October 4-8, 1965. Coverage includes an examination of the hydrologic and water management problems of both the northern and southern regions of West Siberia and a review of plans for use and development of water in the Ob River basin and in the southern regions of Kazakhstan and Central Asia. Intended to be provocative, the book examines the feasibility of, and the dangers inherent in, construction of a hydroelectric power plant on the Lower Ob in the vicinity of Salekhard. Emphasis is placed on the negative aspects of the construction picture in an ecological context, to accentuate the need for careful evaluation and prudent management of the water and other resources of the area. (See also W72-02062 thru W72-02070) (Josefson-USGS)

W72-02061

COMPLEX-USE MANAGEMENT OF WATER RESOURCES OF THE OB RIVER BASIN (KOMPЛЕКСНОЕ ИСПОЛЬЗОВАНИЕ ВОДНЫХ РЕСУРСОВ ОБСКОГО БАССЕЙНА), All-Union Designing, Surveying, and Scientific Research Inst. Hydroproject, Moscow (USSR).

A. N. Chemin.

In: Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 15-23, 1970.

Identifiers: *Water resources, *Water resources development, *Water management (Applied), *Administration, Adoption of practices, Decision making, Natural resources, Fish management, Navigation, Industries, Reservoirs, Dams, Hydroelectric plants, Hydroelectric power, Surface runoff.

Identifiers: *USSR, *West Siberia, Ob River, Irtysh River, Water power.

The Ob-Irtysh River basin covers an area of 3 million sq km and includes the Omsk, Novosibirsk, Tomsk, Kemerovo Oblasts and Altay Territory; the Tyumen' Oblast and part of the Kurgan and Sverdlovsk Oblasts, and part of Northern Kazakhstan. The volume of surface runoff in the basin in an average water year is 400 sq km or about 10% of the surface runoff of the USSR. The water resources of the basin are concentrated mainly in the taiga regions of the Tyumen' and Tomsk Oblasts, where 83% of the total surface runoff occurs. The potential water power of the Ob basin is estimated to be 250 billion kw-hr, which amounts to about 10% of the total water power potential of the USSR. Water power resources are distributed unevenly throughout the area: 30% in the Tyumen' Oblast, 35% in the Altay Territory, 15% in the East Kazakhstan Oblast of Kazakhstan, and 20% in the Kemerovo, Novosibirsk, and Tomsk Oblasts. Work is currently underway to find the most feasible reservoir site for the Lower Ob Hydroelectric Power Plant, which, by technical and economic standards, is comparable with the large hydroelectric power plants on the Volga. Complex-use management of the water power of the Ob basin will create favorable conditions for the development of all branches of water management in the area and will provide for effective control of flooding, water erosion, bank destruction, and channel silting. (See also W72-02061) (Josefson-USGS)

W72-02062

NATURAL MOISTURE CONDITIONS OF THE OB BASIN AND PROSPECTS OF WATER DEVELOPMENT (TESTESTVENNYYE USLOVIYA UVLAZHENIYA TERRITORII OB-SKOGO BASSEYNA I PERSPEKTIY GIROMELIORATSIY), Omskii Selskokhozyaistvennyi Institut (USSR).

V. S. Mezentsev, and I. V. Karnatsevich.
In: Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 42-52, 1970. 5 fig, 2 tab, 5 ref.

Identifiers: *Water resources development, *Project feasibility, *Reservoir construction, *Environmental effects, *Natural resources, Heat balance, Water balance, Irrigation practices, Drainage, Land reclamation, Climatic zones, Climatic data, Precipitation (Atmospheric), Evaporation.

Identifiers: *USSR, *West Siberia, Ob River, Salekhard, Radiation balance.

The heat and water balance of the Ob River basin for an average year was examined to develop improved irrigation, drainage, and reclamation measures. Particular concern is voiced over plans of the All-Union Planning, Surveying, and Scientific Research Institute (Gidroproyekt) to construct a reservoir on the Lower Ob in the vicinity of Salekhard. Building of the reservoir at this site is viewed as having a damaging influence on the hydrologic and climatic conditions of the northern part of West Siberia and as creating an obstacle to the reclamation and exploitation of the natural productive resources of the area. The negative effects anticipated in the wake of the proposed construction include: (1) raising of the groundwater level; (2) inundation of wide coastal areas followed by extensive loss of forest vegetation; (3) considerable change in the atmospheric circulation processes over the immediate vicinity and in the coastal zone; (4) disruption of the climatic balance; (5) change in the ice regime; (6) deterioration of the thermal regime of air and soil over wide areas; (7) inaccessibility of mineral, forest and peat resources; and (8) loss of effective control of drifting peat islands. These and other factors should outweigh any

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

benefits that might be obtained. (See also W72-02061) (Josefson-USGS)
W72-02063

FISH MANAGEMENT IN THE OB RIVER BASIN IN THE LIGHT OF POSSIBLE CONSTRUCTION OF THE LOWER OB HYDROELECTRIC POWER PLANT (RYBNOYE KHOZYAYSTVO OBSKOGO BASSEYNA PRI USLOVII SOZDANIYA NIZHNE-OBSKOY GES), A. N. Petkevich.

In: Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 59-65, 1970.

Descriptors: *Water resources development, *Construction, *Hydroelectric plants, *Feasibility studies, *Fish management, Fish conservation, Fish, Fish populations, Schools (Fish).

Identifiers: *USSR, *West Siberia, Yamalo-Nenets National District, Salekhard, Ob River, Whitefish, Sturgeon.

Planned construction of the lower Ob Hydroelectric Power Plant in the vicinity of Salekhard (Yamalo-Nenets National District) will harm the interests of fish management in the Ob River basin and incur great economic losses, which cannot be recovered by any expenditures subsequently allocated to restore the fishery economy. The dam of the hydroelectric power plant will flood and destroy the spawning beds of whitefish in the Ural tributaries of the river and inundate the feeding grounds of all species of migrating fish in the Lower Ob. Operation of the plant will have the following results in the downstream reaches: (1) change in the high-water level; (2) alteration of the thermal regime of the water; (3) reduction in the food supply for fish; (4) creation of periodic shoaling of delta anabanches; (5) disruption of migration rhythms of the fish; and (6) salinization of the bays to the point where local schools of fish in the delta and Gulf of Ob will be drastically reduced. The potential fish reserve of the basin is estimated to be 1 million centners, including 650,000 centners in the Tyumen' Oblast. The total loss to the fish industry by construction of the plant will be 400,000 centners of whitefish, salmon, and sturgeon, which, in monetary terms, will amount to 50 million rubles a year. (See also W72-02061) (Josefson-USGS)
W72-02064

SURFACE-WATER RESOURCES OF THE OB RIVER AND OB-IRTYSH INTERFLUVE (RESURSY POVERKHNOSTNYKH VOD R. OBI I OB-IRTYSHSKOGO MEZHDURECH'YA), Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).

K. P. Voskresenskiy, V. V. Kupriyanov, and M. S. Protas'yev.

In: Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 66-74, 1970. 2 fig, 3 tab.

Descriptors: *Water resources, *Surface waters, *Streamflow, *Runoff, *Discharge (Water), Interfluvia, Rivers, Watersheds (Basins), Lakes, Intermittent streams, Water storage, Probability. Identifiers: *USSR, *West Siberia, Ob River, Irtysh River.

Surface waters of the Ob River and Ob-Irtysh interfluvia south of Novosibirsk consist of (1) the runoff of the Ob River; (2) the uniform runoff of rivers flowing into the Ob, the Kulunda and Kuchuk Lakes, and into Lake B. Chany; (3) the flow in a large number of intermittent streams, where runoff occurs mainly during the period of spring high water; (4) the water storage in river pools; and (5) the water storage in lakes. Average annual streamflow of the Ob River at its confluence with the Biya and Katun' Rivers is 35 cu km and at its outlet near Atamanovo about 51 cu km. Average annual discharge of rivers of the Ob-Irtysh interfluvia is 9,453 cu km, of which 8,610 cu km is the runoff of rivers of the Ob Plateau and 0.843 cu km the runoff of rivers flowing into drainless lake depressions. Al-

most all of these waters (8,120 cu km) flow into the Ob from its four tributaries — Peschanaya (980 million cu m), Anuy (940 million cu m), Charysh (5,140 million cu m) and Aley (1,060 million cu m). A clearly expressed increase in the average annual unit discharge (liter/sec/sq km) with a decrease in basin area was observed for Northern Kazakhstan and the Ob-Irtysh interfluvia (south of Novosibirsk) and may be explained by more favorable condition of snow accumulation and reduced evaporation on the small watersheds. (See also W72-02061) (Josefson-USGS)
W72-02065

LONG-TERM WATER BALANCE OF THE IRTYSH RIVER IN KAZAKHSTAN (PERSPEKТИVNYY VODOKHYZYASTVENNYY BALANS R. IRTYSHA V KAZAKHSTANSKOY CHASTI), Akademiya Nauk Kazakhskoi SSR, Alma-Ata.

V. P. Zakharov, and M. N. Vagapov.

In: Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 81-85, 1970.

Descriptors: *Water resources, *Water demand, *Water requirements, *Water consumption (excludes consumptive use), *Water utilization, Water users, Diversions, Regulation, Streamflow, Runoff, Discharge (Water), Irrigation.

Identifiers: *USSR, *West Siberia, Kazakhstan, Irtysh River, Ob River, Irrigated agriculture.

The Irtysh River is the only large source of water in the eastern and northeastern part of Kazakhstan and is a very important transportation artery for both Kazakhstan and West Siberia. Average annual streamflow of the Irtysh in Kazakhstan is about 34.7 cu km/yr, which represents about 30% of the total surface-water resource of the Kazakh Republic. The total 1970 requirements for water in the Irtysh basin by all branches of the national economy were determined on the basis of a water consumption figure of 7.7 cu km/yr. Projected to 1980, the total demand for these waters by all branches of water management (excluding those in the Chinese People's Republic) will be 11.9 cu km/yr. Considering the development of other branches of the national economy at a level comparable to that of agricultural production, the total demand for water by Kazakh water management regions associated with the Irtysh basin is about 110 cu km/yr. To meet this requirement, 65 cu km/yr must be derived from sources other than the Irtysh and Upper Ob. This may be met by utilizing the middle and lower reaches of the Ob and the Yenisey basin. (See also W72-02061) (Josefson-USGS)
W72-02066

WATER AND HYDROELECTRIC POWER RESOURCES OF THE UPPER IRTYSH BASIN (VODNYYE I VODNOENERGETICHESKIYE RESURSY BASSEYNA VERKHNEGO IRTYSHA), L. D. Lavrent'yeva, and I. S. Sosedov.

In: Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 86-90, 1970. 3 fig.

Descriptors: *Water resources, *Hydroelectric power, *Water utilization, Streamflow, Runoff, Topography, Climatology.

Identifiers: *USSR, *West Siberia, Kazakhstan, Irtysh River, Water power.

The upper part of the Irtysh basin, located on the western side of the Altay Mountain System, occupies a special place in the water power balance of the basin and of neighboring regions in Kazakhstan and West Siberia. The average annual streamflow from the area is 29.3 cu km, of which two-thirds or 19.3 cu km/yr is derived from the territory within the USSR. According to latest figures, the hydroelectric potential of East Kazakhstan is estimated to be 72 billion kw-hr/yr, which amounts to 43% of all water power resources of Kazakhstan. Water power resources of the basin are distributed

as unevenly as the climatic and topographic features which determine them. Much of the hydroelectric power of the basin remains undeveloped: of the 41 billion kw-hr available, only 5 billion kw-hr or 12% is presently in service. (See also W72-02061) (Josefson-USGS)
W72-02067

FORMATION OF SPRING RUNOFF IN THE VASYUGAN'YE (O FORMIROVANII VESENNEGO STOKA V USLOVIYAKH VASYUGAN'YE), Tomsk State Univ. (USSR).

D. A. Burakov.

In: Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 121-126, 1970. 3 fig, 2 tab, 5 ref.

Descriptors: *Runoff, *Streamflow, *Floods, *Water balance, Discharge (Water), Water levels, Water storage, Inflow, Perched water, Melt water, Snowmelt, Precipitation (Atmospheric), Interfluvia, Watersheds (Basins), Bogs, Seasonal, On-site investigations.

Identifiers: *USSR, *West Siberia, Vasyugan'ye, Ob River, Irtysh River, Snow storage.

The Vasyugan'ye is a huge waterlogged area located in the Ob-Irtysh interfluvia in a subzone of the southern taiga. Field investigations were conducted in 1965 in the 75 sq-km Klyuch River basin to study the formation of high water flowing from the Bakchar bog tract. The region examined is typical of the Vasyugan'ye. Data on the water balance of the basin during the period of high water include: maximum water storage in snow (155 mm), liquid precipitation during snowmelt (35 mm), total amount of water received (190 mm), runoff losses (143 mm), and net spring runoff (47 mm). Of particular note is the very high value of the spring runoff loss, which amounts to 75% of the total amount of water received. According to runoff, snow storage and precipitation data available, the spring runoff loss for rivers of the Vasyugan'ye is high and averages 95-110 mm. (See also W72-02061) (Josefson-USGS)
W72-02068

COMPLEX-USE MANAGEMENT OF THE KARASUK-BURLA LAKES (KOMPLEKSNOYE KHOZYAYSTVENNOYE ISPOL'ZOVANIYE KARASUKSKO-BURLINSKIKH OZER), Novosibirsk Pedagogical Inst. (USSR).

V. P. Tyshko.

In: Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 154-160, 1970. 2 fig, 1 tab, 10 ref.

Descriptors: *Lakes, *Water resources, *Water management (Applied), *Water pollution, *Pollution abatement, Waste water (Pollution), Water utilization, Water supply, Fish, Fish management, Irrigation, Sanitary engineering.

Identifiers: *USSR, *West Siberia, Novosibirsk Oblast, Altay Territory.

The Karasuk-Burla group of lakes, located in the Karasuk Rayon of the Novosibirsk Oblast and in the Burla Rayon of the Altay Territory, consists of several scores of large and small lakes and covers a total area of 636 sq km. Conditions in the two regions are conducive to the development of irrigated agriculture. According to the data of the Leningrad State Institute for the Design and Planning of Water Management, 88.5% of the lands of the lake region are suitable for irrigation. Improvement of the aquatic habitat and expansion of fishing are recommended and may be realized through the amelioration of the hydrologic and hydrochemical regime of the lakes. Antipollution procedures, including the use of agricultural waste-water collection systems and adoption of strict sanitary engineering practices, should be instituted to improve water supplies for agricultural and domestic use and to reduce the hazards of lake water pollution

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Control of Water on the Surface—Group 4A

resulting from a growing application of fertilizers and toxic chemicals, and the lack of effective public health protection. (See also W72-02061) (Josenson-USGS)
W72-02069

INVESTIGATIONS OF MOISTURE EXCHANGE IN THE ZONE OF AERATION IN IRRIGATED LAND (ISSLEDOVANIYA VLAGOBOBMENA V ZONE AERATII NA OROSHAYEMYKH ZEMLYAKH),

Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).

S. I. Kharchenko.

In: Kompleksnoye osvoyeniye vodnykh resursov Oskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 161-169, 1970. 4 fig, 3 tab, 3 ref.

Descriptors: *Soil moisture, *Soil water, *Groundwater, *Groundwater movement, *Zone of aeration, Root zone, Soils, Irrigated land, Irrigation, Irrigation water, Water table, Water balance, Water storage, Infiltration, Evaporation, Evaporation pans, Lysimeters, Cores.

Identifiers: *USSR, *West Siberia, Kulunda Stepe, Moisture exchange, Irrigation rates, Water balance equations.

The mechanism of moisture exchange in the zone of aeration is quite complex and depends upon a combination of many processes: infiltration, evaporation from the soil, plant transpiration, and movement of vaporous, film, and capillary moisture under the effect of the thermal gradient and capillary forces. The upward movement of groundwater into the root zone of soil in regions with a shallow water table plays an important role in the supply of moisture to crops and in the movement of salts in the zone of aeration and must be taken into account in calculating irrigation rates and irrigation regimes. When the depth to the groundwater table is 1.5-2.0 m, the upward movement of groundwater into the root zone of the soil reduces the amount of irrigation water needed and the frequency of application to one-half or one-third that required under deep water-table conditions. To formulate plans to construct flooding and irrigation systems in the Kulunda Steppe, it is necessary to consider: (1) fluctuations of the meteorological elements during a growing season; (2) structure of the water balance in the zone of aeration; and (3) depth of the groundwater table. (See also W72-02061) (Josenson-USGS)
W72-02070

FLOODS IN HARVARD SOUTHWEST QUADRANGLE, NORTHEASTERN ILLINOIS, Geological Survey, Oak Park, Ill.

For primary bibliographic entry see Field 02E.
W72-02085

HYDROLOGIC EFFECTS OF WATER CONTROL AND MANAGEMENT OF SOUTHEASTERN FLORIDA,

Geological Survey, Tallahassee, Fla.

S. D. Leach, H. Klein, and E. R. Hampton.

Geological Survey Open-file Report 71005, 1971. 47 fig, 12 tab, 25 ref.

Descriptors: *Water resources development, *Flow augmentation, *Flow control, *Environmental effects, *Florida, Surface waters, Groundwater, Estuaries, Saline water intrusion, Streamflow, Runoff, Aquifers, Groundwater recharge, Drainage effects, Canals, Levees, Water yield, Water quality, Salinity, Withdrawal, Water users, Urbanization, Cities.
Identifiers: *Florida (Southeast), Urban hydrology, Everglades (Fla.).

The prime effect of the water-control works in south Florida has been to facilitate the flow of water out of the Everglades by means of the canal system, thereby changing the spatial and temporal distribution of runoff from the Everglades. Reduc-

tion in flow to the ocean began with completion of levee systems in 1953. Discharge to the ocean through Miami Canal was reduced an average of 185,000 acre-feet per runoff year for 1956-65, and combined discharge from North New River, Hillsboro, and West Palm Beach canals was reduced about 294,600 acre-feet per runoff year for 1953-65, from the average discharge of 1940-52. Overall reduction of fresh water flow to the ocean since 1953 as a result of flood and water-control measures is about 20 percent of the fresh water that otherwise would have been discharged to the ocean in southeastern Florida. One principal effect of earlier land-reclamation practices was the lowering of groundwater levels throughout the coastal ridge and interior areas. Overdrainage of many coastal areas allowed sea-water intrusion of canals and the Biscayne aquifer, the source of nearly all potable water in the area. The overdrainage has been arrested and, since 1954, water levels have tended to stabilize in most of Dade County. (Woodard-USGS)
W72-02090

MODEL OF SPRING RUNOFF FORMATION AND ITS APPLICATION TO HYDROGRAPH FORECASTING (MODEL FORMIROVANIYA VESENNEGO STOKA I VEYE REALIZATSIYA DL'YA PROGNOZA GIDROGRAFA),

Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr, Leningrad (USSR).

For primary bibliographic entry see Field 02E.
W72-02096

PRESENT-DAY AND LONG-TERM WATER AND SALT BALANCE OF SOUTHERN SEAS OF THE USSR (AZOV, CASPIAN AND ARAL) AND POSSIBLE CHANGES IN THEIR HYDROLOGIC AND HYDROCHEMICAL REGIMES (SOVREMENNYY I PERSPEKTIVNYY VODNYY I SOLEVY BALANSY I VOZMOZHNNYE IZMENENIYA GIDROLOGICHESKOGO I GIDROKhimICHESKOGO REZHMIV YUZHNYKH MOREY SSSR (AZOVSKOGO, KASPIYSKOGO I ARALESKOGO), State Oceanographic Inst., Moscow (USSR). For primary bibliographic entry see Field 02H.
W72-02099

PROBLEMS IN THE IRRIGATION OF THE KULUNDA STEPPE (NEKOTORYYE VOPROSY OROSHENIYA KULUNDINSKOGO STEPPI), Leningrad State Inst. for the Design and Planning of Water Management (USSR).

For primary bibliographic entry see Field 03F.
W72-02101

DETERMINATION OF NONLINEAR FUNCTIONAL RESPONSE FUNCTIONS IN RAINFALL-RUNOFF PROCESSES,

California Univ., Davis. Dept. of Water Science.

For primary bibliographic entry see Field 02A.
W72-02116

MATHEMATICAL FOUNDATIONS FOR DESIGN: CIVIL ENGINEERING SYSTEMS,

Delaware Univ., Newark, N. J. Dept. of Civil Engineering.

For primary bibliographic entry see Field 06A.
W72-02127

DIGITAL SIMULATION OF AN EXISTING WATER RESOURCES SYSTEM,

Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.

For primary bibliographic entry see Field 06A.
W72-02132

WINTER COMMERCE ON THE BALTIC: SOME IMPLICATIONS ON OPENING THE GREAT LAKES,

Michigan State Univ., East Lansing. Graduate School of Business.

For primary bibliographic entry see Field 06B.
W72-02143

ECONOMIC EVALUATION OF SOME WATERSHED MANAGEMENT ALTERNATIVES ON FOREST LAND IN WEST VIRGINIA,

Forest Service, Columbus, Ohio. Northeastern Forest Experiment Station; and Forest Service, Parsons, West Va. Northeastern Forest Experiment Station.

D. P. Worley, and J. H. Patric.

Water Resources Research, Vol 7, No 4, p 812-818, August, 1971. 3 fig, 4 tab, 1 ref.

Descriptors: *Streamflow, *Watershed management, *Vegetation regrowth, *Cutting management, *Water costs, West Virginia, Hardwood, Forest management.

Identifiers: *Timber growth, Product substitution.

A case study of the Fernow Experimental Forest provided data over a 10-year period to model an approach for evaluating streamflow increases in terms of timber growth values forgone. The quality and quantity of streamflow was examined by treating the Fernow watersheds with a series of six management alternatives ranging from no timber cutting to complete vegetation removal. The extent of product substitution (streamflow versus timber volume) is analyzed in four stages. Light cutting (up to one-fourth of the timber volume) slightly increased the value of timber growth as well as the amount of streamflow. Cutting one-third to one-half of the merchantable volume sacrificed timber growth for streamflow gain. Cutting one-half to three-fourths of the timber volume resulted in small streamflow increases for large sacrifices in timber regrowth. Cutting three-fourths or more of the forest vegetation provided major increases in streamflow but no return from timber. Average annual water costs ranged from no cost for small streamflow increases to \$1.30 per thousand gallons maximum streamflow increases. (Haug-Wisconsin)
W72-02146

THE CHALUS VALLEY AND ITS TERRACES: STUDIES IN THE HISTORY AND REGIONALIZATION OF THE CENTRAL ELBUR (NORTH IRAN) (DAS CHALUS-TAL UND SEINE TERRASSEN, STUDIEN ZUR LANDSCHAFTSGLEIDERUNG UND LANDSCHAFTSGESCHICHTE DES MITLEREN ELBURS, (NORDIRAN),

E. Ehlers.

Erkundung, Vol 23, No 3, p 215-229, September 1969. 8 fig, 30 ref.

Descriptors: *Terraces (Geological), *Geomorphology, *River basins, *Vegetation, *Pleistocene epoch, Terrain analysis, Arid lands, Foreign countries, On-site investigations, Geologic time, Geologic investigations, Climatic data, Geographical regions.

Identifiers: *Iran.

The middle Elbur River in north Iran offers in its vertical, as well as its horizontal regionalization, a richly varied terrain. The northern reaches of the Elbur takes on particular importance as an east-west barrier between the semiarid-arid warm steppes and deserts of the Iranian highlands to the south and the cold dry deserts of central Asia to the north. It is possible to distinguish 5 subregions in the Chalus Valley with geologic and geomorphologic individuality. The horizontal divisions of the valley according to relief are further strengthened by the succession of 5 different floras and vegetation is also vertically stratified into 5 different levels ranging from south Caspian lowland forest to above-treeline mountain steppe. The Chalus terraces, to the extent that their numbers and classification are obviously similar to other valleys of the Elbur north flank, are significant in dating the Pleistocene and postglacial climatic and landscape history of north Persia as to drier warm and colder wet periods. (Casey-Arizona)
W72-02207

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

SOUTH AFRICA AND ITS WATER PROBLEM (L'AFRIQUE DU SUD ET LE PROBLEME DE L'EAU), L. Capstickdale.

L'Eau, 1969, No 2, p 61-68. 2 map, 6 photo.

Descriptors: *Water resources development, *Storage, *Reservoir evaporation, Average precipitation, Irrigation, Ground water basins, Ground water recharge, Mineral water, Water pollution control, Reservoir construction.

Identifiers: *Republic of South Africa, Orange River.

Compared to other western countries of the same industrial and economical development, South Africa has very poor hydraulic resources. The mean annual precipitation index on the 1,223,400 square km. country is 478.98 mm from which 8.6% is runoff water. Irrigation is a very important factor; groundwater is seldom and occurs in very limited areas; and mineral content dissolved in the water is high. Climatic conditions, hydraulic reserves, water consumption for irrigation and municipal and industrial purposes, water storage and water used for cooling, artificial recharge, and water treatment are described. Water pollution control is discussed. The construction of large reservoirs such as the two planned at Oxbow and Kau and the already finished du Vaal, Bridle Drift, Oppermansdrift, Spioenkop, Doornhoek, Pongolapoort and Kruger National Park dams are reviewed as well as water management of the Orange River. (Minguez-Arizona) W72-02209

HYDROLOGY AND WATER RESOURCES IN ARIZONA AND THE SOUTHWEST, VOLUME L

American Water Resources Association.

Copies may be obtained from Arizona Section AWRA, Secretary-Treasurer, 1525 East Kleindel Road, Tucson, Arizona 85719. Proceedings of the 1971 Meetings of the Arizona Section-American Water Resources Assn. (AWRA) and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Arizona.

(See W72-02213 thru W72-02238).
W72-02212

AUGMENTING ANNUAL RUNOFF RECORDS USING TREE-RING DATA,

Arizona Univ., Tucson. Lab. of Tree-Ring Research.

For primary bibliographic entry see Field 02E.
W72-02213

SOME REGIONAL DIFFERENCES IN RUNOFF-PRODUCING THUNDERSTORM RAINFALL IN THE SOUTHWEST,

Southwest Watershed Research Center, Tucson, Ariz.

For primary bibliographic entry see Field 02B.

W72-02214

UNCERTAINTIES IN DIGITAL-COMPUTER MODELING OF GROUNDWATER BASINS,

Geological Survey, Tucson, Ariz.; and Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 02F.

W72-02215

SEASONAL EFFECTS ON SOIL DRYING AFTER IRRIGATION,

Agricultural Research Service, Phoenix, Ariz.

Water Conservation Lab.

For primary bibliographic entry see Field 02D.

W72-02217

BLUE-GREEN ALGAL EFFECTS ON SOME HYDROLOGIC PROCESSES AT THE SOIL SURFACE,

Arizona Univ., Tucson. Water Resources Research Center.

For primary bibliographic entry see Field 02G.
W72-02218

EFFECTS OF FIRE ON WATER INFILTRATION RATES IN A PONDEROSA PINE STAND,

Arizona Univ., Tucson.

For primary bibliographic entry see Field 02G.
W72-02219

THE USE OF A REALISTIC RAINFALL SIMULATOR TO DETERMINE RELATIVE INFILTRATION RATES OF CONTRIBUTING WATERSHEDS TO THE LOWER GILA BELOW PAINTED ROCK DAM,

Arizona Univ., Tucson. Water Resources Research Center.

For primary bibliographic entry see Field 02G.
W72-02220

MULCHING TECHNIQUES FOR ARID LANDS VEGETABLE PRODUCTION,

Arizona Univ., Tucson. Dept. of Horticulture.

For primary bibliographic entry see Field 03F.

W72-02221

FIELD MEASUREMENTS OF SOIL-WATER CONTENT AND SOIL-WATER PRESSURE,

Agricultural Research, Phoenix, Ariz. Water Conservation Lab.

For primary bibliographic entry see Field 02G.
W72-02222

CONDITIONAL STREAMFLOW PROBABILITY DISTRIBUTIONS,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 06A.

W72-02223

A STOCHASTIC ANALYSIS OF FLOWS ON RILLITO CREEK,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 02E.

W72-02224

THE USE OF CHEMICAL HYDROGRAPHS IN GROUNDWATER QUALITY STUDIES,

Harshbarger and Associates, Tucson, Ariz.

For primary bibliographic entry see Field 05A.

W72-02225

RECHARGING THE OGALLALA FORMATION USING SHALLOW HOLES,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources; and Texas Tech Univ., Lubbock.

Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 04B.

W72-02227

MANAGEMENT OF ARTIFICIAL RECHARGE WELLS FOR GROUNDWATER QUALITY CONTROL,

Arizona Univ., Tucson. Water Resources Research Center.

For primary bibliographic entry see Field 05G.

W72-02228

THE OCCURRENCE OF THERMAL GROUND-WATER IN THE BASIN AND RANGE PROVINCE OF ARIZONA,

Arizona Univ., Tucson. Dept. of Geosciences.

For primary bibliographic entry see Field 02F.

W72-02229

PROGRESS IN DEVELOPING FOREST MANAGEMENT GUIDELINES FOR INCREASING SNOWPACK WATER YIELDS,

Arizona Univ., Tucson. Dept. of Watershed Management.

D. B. Thorud, and P. F. Ffolliott.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 291-300, 1971. 1 fig, 13 ref.

Descriptors: *Forest management, *Snowmelt, *Runoff, *Water yield improvement, *Project planning, Ponderosa pine trees, Vegetation effects, Soil types, Topography, Climatic data, Runoff forecasting, Arizona, Mountains. Identifiers: *Pert networks, *Runoff efficiency.

Snowmelt is a major source of runoff in Arizona for both reservoir systems and groundwater recharge. Because much of the Arizona snowmelt runoff occurs in Ponderosa pine forests, it follows that appropriate forest management methods may enhance snowmelt water yield by manipulating tree spacing or overstory density. This paper attempts to establish guidelines for evaluating such forest management practices. Physiographic and climatic factors also affect runoff quantity, and it is conceivable that 2 sites of identical vegetation composition, but different in some combination of these factors might yield quite different amounts of runoff in response to some management practice. A PERT network is presented illustrating the investigative framework for such a research effort. The major study activities of the framework are the identifying developing preliminary evaluations and preparing a comprehensive report. Three inventory evaluations to attempt identification of pertinent populations are currently being conducted and are described. (See also W72-02212) (Casey-Arizona) W72-02230

OPTIMAL UTILIZATION OF PLAYA LAKE WATER IN IRRIGATION,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 03F.

W72-02231

COLLECTIVE UTILITY: A SYSTEMS APPROACH FOR THE UTILIZATION OF WATER RESOURCES,

Arizona Univ., Tucson. Dept. of Systems Engineering.

For primary bibliographic entry see Field 04B.

W72-02232

COMPARISON OF WATER PRICING STRUCTURES FROM A COLLECTIVE UTILITY VIEWPOINT,

Arizona Univ., Tucson. Dept. of Systems Engineering.

For primary bibliographic entry see Field 06C.

W72-02233

TREE-RING DATING OF COLORADO RIVER DRIFTWOOD IN THE GRAND CANYON,

Arizona Univ., Tucson. Lab. of Tree-Ring Research.

For primary bibliographic entry see Field 07B.

W72-02234

PHYSIOGRAPHIC LIMITATIONS UPON THE USE OF SOUTHWESTERN RIVERS,

Museum of Northern Arizona, Flagstaff.

For primary bibliographic entry see Field 06B.

W72-02235

USE AND ABUSE OF SOUTHWESTERN RIVERS. THE PUEBLO DWELLER,

American Foundation, Inc., Dragoon, Ariz.

For primary bibliographic entry see Field 03F.

W72-02236

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Groundwater Management—Group 4B

USE AND ABUSE OF SOUTHWESTERN RIVERS. HISTORIC MAN—THE SPANIARD, Southwestern Mission Research Center, Tucson, Ariz.

C. W. Polzer.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 387-396, 1971. 13 ref.

Descriptors: *History, *Arid lands, *Irrigation practices, *Arizona, Water resources development, Water users, Water conservation, Arroyos, Rivers, Cultural control, Exploitation, Exploration.

The early Spanish explorers did not lean toward rivers and boats. Bred in the culture of an arid land, they naturally explored with horses or by foot, leaving boats and rafts to the English and French. No historical records reveal any Spanish desires or attempts to control river flow or harness desert water resources on any appreciable scale. Yet they transformed the Sonoran Desert into a productive garden land never before achieved by indigenous peoples. Pueblos were built on river banks where alluvial fans could be easily irrigated. Small arroyo check dams diverted water into wells and town tanks, while larger diversion dams were built to draw water into canals for crop irrigation. The dams were designedly weak and efficient only to the point of diverting sufficient water for the pueblo. There is no concept of storing water in reservoirs or lakes for periods of scarcity, but only of tapping enough water during periods of excess flow. All surplus water was allowed to flow downstream for the use of others in their struggle for survival. In this way the Spanish achieved a balance between human needs and the limited resources of the desert. The records of the Mexicans and the Anglos have been much more exploitative and destructive. (See also W72-02212) (Casey-Arizona) W72-02237

USE AND ABUSE OF SOUTHWESTERN RIVERS. HISTORIC MAN—THE ANGLO, Arizona State Univ., Tempe.

B. Fireman.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association, and the Hydrology Section-Arizona Academy of Science, April 22-23, Tempe, Vol 1, p 397-403, 1971.

Descriptors: *History, *River basins, *Water resources development, Dams, *Arid lands, Arizona, Water conservation, Exploitation.

The exploitation of southwestern rivers is discussed in the context of American intrusion, acquisition and development of Arizona. The first Americans in the region were beaver trappers who quickly decimated the Sonoran beaver but otherwise wrought little environmental impact. Immediately following the acquisition of the region by the U.S. after the Mexican War, gold miners descended upon it from California. They quickly scarred hills and streams, diverting water for placers, building piles of ugly rubble and logging off entire forests. The large numbers of people and towns that followed created a need for more home grown food products and large storage dams were soon built. When these washed out the stored floodwaters did more sharp, tragic damage downstream than even the seasonal floods of the past. The common municipal practice of dumping raw sewage into waterways soon brought water pollution. Following the National Reclamation Act of 1902, large dams were soon built on major waterways and the multiple use projects came into existence. Today, even the Indians, in their quest for economic betterment are destroying natural waters. They have learned a major lesson from the whites—the rivers they used only for basic needs a century ago, may be more profitable if overused without regard for tomorrow. (See also W72-02212) (Casey-Arizona) W72-02238

4B. Groundwater Management

URANIUM AND TRITIUM AS NATURAL TRACERS IN THE FLORIDAN AQUIFER, Florida State Univ., Tallahassee. Dept. of Geology. J. K. Osmond, and B. F. Buie.

Available from National Technical Information Service as PB-204 893, \$3.00 in paper copy, \$0.95 in microfiche. Florida Water Resources Research Center, Gainesville, Publication No 14, Aug 1971. 66 p, 12 fig, 8 tab, 39 ref, 3 append. OWRR-A-011-FLA (8).

Descriptors: *Tritium, *Uranium radioisotopes, *Groundwater recharge, *Aquifers, *Tracers, Groundwater movement, Springs, Florida.

Identifiers: Wakulla Springs (Fla), Silver Springs (Fla).

Naturally occurring radioisotopes serve as hydrologic tracers in the study of ground water movement and aquifer recharge. A benzene synthesis method of tritium analysis involving no isotopic enrichment has been developed which permits analysis of samples at a level of 10 or more tritium units (10 plus H-3 per 1018 H-1). In the North Florida study area sharp boundaries separate young and old waters in the aquifer according to their tritium content. Uranium in ground water exhibits extreme variability in isotopic distribution and the combination of isotopic ratio (U-234/U-238) and total uranium concentration (0.0X to X parts per billion) serves as the tag with which to trace aquifer water. The sources of water flowing from Wakulla Springs and Silver Springs is calculated quantitatively; the results agree well with conclusions based on standard hydrologic methods of analysis. Uranium analysis requires one to four gallons of water per sample, and involves isotopic spiking with U-232, iron hydroxide co-precipitation, ion exchange separation, electrodeposition, vacuum counting, and alpha pulse height analysis. (Morgan-Florida) W72-01696

ANNUAL WATER STATEMENT, 1970-1971, High Plains Underground Water Conservation District No. 1, Lubbock, Tex.

The Cross Section, Vol. 17, No. 2, p. 1-7, February 1971. 17 tab, 15 fig.

Descriptors: *Groundwater mining, *Water levels, *Water table, *Hydrologic data, Water wells, Overdraft, Water supply, Maps, Great Plains, Texas.

Identifiers: Texas High Plains.

Groundwater data for 15 counties in the Texas High Plains is presented as water-level information for 1970-1971. Lists of average 10-year water-table decline and summary of current data are included. Potter County had the largest average water-table decline in 1970-1971, a 6.66-foot value. Parmer County had the largest average water-table decline in 1962-1971, a 4.06-foot value. There are 15 well location maps. (Popkin-Arizona) W72-01743

CHANGE OF CHLORIDE CONTENT OF WATER IN RESPONSE TO PUMPING IN THE ARTESIAN AQUIFER IN THE ROSWELL-EAST GRANT PLAINS AREA, CHAVES COUNTY, NEW MEXICO, New Mexico State Engineer Office, Albuquerque. F. H. Hennighausen.

In: Saline Water, Mattox, R. B. (ed.), AAAS, Committee on Desert and Arid Zones Research, Contribution No 13, p 71-86, 1970. 8 fig, 1 tab, 6 ref.

Descriptors: *Artesian wells, *Saline water, *New Mexico, *Groundwater basins, *Aquifers, Semiarid climates, Great Plains, Chlorides, Hydrograph analysis, Overdraft, Hydrogeology.

Identifiers: *Artesian head.

The Roswell Artesian Basin of southeastern New Mexico consists principally of two distinct aquifers: an artesian aquifer of Permian Age and a shallow aquifer of Quaternary Age. Prior to agricultural exploitation of the region, the artesian system of the basin was in equilibrium and most of the natural discharge from the artesian aquifer occurred at large springs and seeps. With the development and use of artesian wells the springs failed rapidly. Artesian head in the Roswell Basin has declined almost continuously since shortly after the first artesian wells were drilled in the 1890's. There is a general correlation between pumping, artesian head and rainfall. Saline water (as measured by chloride content) has encroached into the fresh water portion of the artesian aquifer since 1952 and has retreated in some parts of the aquifer since 1965 in response to fluctuations in artesian head caused by pumping of water from the aquifer. The saline water movement is both vertical and lateral in response to accumulative overdraft of the whole basin, and to seasonal declines of the artesian head. If the pumping rate increases due to drought or other conditions, the recent general overall improvement of water quality will reverse and further encroachment of saline water can be expected in the area. (See also W72-01749) (Casey-Arizona) W72-01751

GEOTHERMICS IN NORTH AMERICA: PRESENT AND FUTURE,

New Mexico State Bureau of Mines and Mineral Resources; and Wyoming State Engineer's Office, Cheyenne.

W. K. Summers, and S. H. Ross. Earth Science Bulletin, Vol 4, No 1, p 7-22, March 1971. 11 fig, 38 ref.

Descriptors: *Geothermal studies, *Mexico, *Exploration, Exploitation, Thermal powerplants, Thermal power, Thermal water, Geologic investigations, Geohydrologic units, Geographical regions, Thermal springs, Foreign countries, Arizona, California, Oregon, Idaho, New Mexico, Utah, Nevada, Washington, Rocky Mountain Region. Identifiers: *Geothermal power.

Geothermics is the utilization of naturally-occurring hot water and steam. Although this resource has many practical uses, its greatest potential seems to be in the production of geothermal power. Such power has several major advantages: (1) it is economically competitive with more conventional power sources; (2) it may be incremental so that capital expenditures can be made on an 'as needed' basis; (3) it is 'pollution free'; (4) it seems to be virtually inexhaustible. About 45 fields in North America have been test drilled and of these, only about 6 are in the development or production stages. Five developed fields in the U.S. and Mexico, including 2 fields currently producing power, are reviewed in terms of thermal and geological characteristics and power potential. Additional data are presented from tests in fields in El Salvador, Nicaragua, Mexico, and the western U.S., and thermal area maps are included of these regions. Exploration techniques reviewed include geologic mapping, fluid dynamics studies, chemical and physical measurements and test drilling. Various types of nuclear stimulation and a heat-exchange process using super-heated water instead of steam are the most promising development suggestions. Increasing interest prompted passage of a federal Geothermal Steam Act in 1970. (Casey-Arizona) W72-01756

MEASUREMENT AND ANALYSIS OF UNSATURATED FLOW AND GROUNDWATER SURFACE PROFILES RELATED TO RECHARGE AND WITHDRAWALS, Arizona Univ., Tucson.

For primary bibliographic entry see Field 02F. W72-01781

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B—Groundwater Management

SUBSURFACE DISTRIBUTION OF NITRATES BELOW COMMERCIAL CATTLE FEEDLOTS, TEXAS HIGH PLAINS,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
For primary bibliographic entry see Field 05B.
W72-02003

OVERPUMPED ARTESIAN WELLS AMONG A WELL GROUP,
North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
A.-A. I. Kashef.
Water Resources Bulletin, Vol 7, No 5, p 981-990, October 1971. 2 fig, 6 ref.

Descriptors: *Artesian wells, *Drawdown, *Unsteady flow, *Water levels, Groundwater movement, Water yield, Equations, Mathematical studies, Steady flow, Pumping, Aquifer characteristics, Confined water.
Identifiers: *Well interference, Overpumped artesian wells.

When an artesian aquifer is too permeable or of a small depth or when the pumping rate is very high, or whenever all of these conditions exist, the zone near the water well may be relieved from the artesian pressure. The well in such cases may be identified as an overpumped artesian well. The flow region is divided into two distinct zones: (a) the zone immediately around the well where the conditions would be similar to a Gravity Well; in this region, the vertical velocity components exist at all points except those at the impervious boundary; and (b) the radius of influence; in this zone, the stream lines are all radial and horizontal as in the case of an idealized artesian well. The interference between multiple artesian wells can be determined by superimposing the hydraulic heads of the individual wells. However, such superposition cannot be valid if one or more overpumped artesian wells existed because of the existing conditions of gravity flow. Thus a restricted form of superposition may be used, based on the use of unified well equations developed on the basis of the analysis of the hydraulic forces in both steady and transient states of flow. (Knapp-USGS)
W72-02005

RECLAIMED WASTE WATER FOR GROUND-WATER RECHARGE,
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 05D.
W72-02006

AN ALGORITHM FOR LEAST SQUARES ANALYSIS OF DRAWDOWN IN OBSERVATION WELLS,
Research Council of Alberta, Edmonton.
A. Vanden Berg.
Journal of Hydrology, Vol 14, No 1, p 1-18, October 1971. 4 fig, 6 tab, 3 ref, append.

Descriptors: *Drawdown, *Computer programs, *Least squares method, Water wells, Water levels, Steady flow, Data processing, Water table, Artesian wells.

An algorithm for computerized analysis of drawdown in an observation well near a well pumping at constant rate from a semi-infinite, non-leaky aquifer uses the least squares method to determine values of the transmissivity, the storage coefficient, and the distance between the observation well and the image well. An alternate algorithm leads to values which give a least squares fit for data plotted on logarithmic paper. The behavior of the algorithm is solved for three sets of drawdown data with varying amounts of scatter. (Knapp-USGS)
W72-02008

AN EXTENDED THEORY OF DELAYED YIELD FROM STORAGE APPLIED TO PUMPING

TESTS IN UNCONFINED ANISOTROPIC AQUIFERS,
Sheffield Univ., (England). Dept. of Civil Engineering.
N. S. Boulton, and J. M. A. Pontin.
Journal of Hydrology, Vol 14, No 1, p 53-65, October 1971. 2 fig, 6 ref, 3 append.

Descriptors: *Drawdown, *Water yield, *Unsteady flow, *Theis equation, Aquifer characteristics, Water levels, Aquifers, Withdrawal, Permeability, Storage coefficient, Specific yield, Transmissivity.
Identifiers: *Pumping tests, *Aquifer tests.

An equation derived for the drawdown of the water-table under non-equilibrium conditions allows for uniform anisotropy and delayed yield from storage. The allowance for delayed yield involves four parameters. The pumped well and observation wells may penetrate the aquifer to any depth. The theory assumes that the aquifer and water are incompressible and that the drawdown of the water-table is small. Using time-drawdown recordings from a pumping test at a constant rate of discharge, a theoretical curve is closely matched to the field curve by determining suitable values of the parameters. (Knapp-USGS)
W72-02011

ARTIFICIAL GROUND-WATER RECHARGE BY MEANS OF WELLS IN ISRAEL,
Tahal Consulting Engineers Ltd., Tel Aviv (Israel). Div. of Hydrology.
Y. Harpaz.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY 12, Paper 8579, p 1947-1964, December 1971. 11 fig, 1 tab, 16 ref.

Descriptors: *Artificial recharge, *Injection wells, Water management (Applied), Water storage, Water quality, Water costs, Aquifers, Aquifer characteristics, Groundwater recharge.
Identifiers: Israel.

Artificial recharge activities in Israel are an indispensable component of the national water management program. Water quantities recharged by means of wells amounted in 1967-1968 to over 100,000 cu m per annum. The sources of supply for recharge are Lake Kinneret and various groundwater basins. Clogging of wells, caused by silting, accumulation of organic matter, and bacterial growth, is the dominant factor limiting their capacity for recharge. The performance of these wells in sandy, limestone and basalt formations is reviewed. By operating dual-purpose wells, both for pumping and injection, their recharge capacities can be maintained for many years. Effects of recharge and pumping on the movement, displacement, and mixing of recharging and innate waters were also investigated. The overall costs of well recharge ranges from \$0.028 per cu m to \$0.048 per cu m including the price of water at the delivery points of the Jordan-Negev Water Conduit. The lower figures are typical of the cost of recharge in the limestone projects near the conduit and the higher ones of those of the sandy wells of the southern coastal plain. (Knapp-USGS)
W72-02077

GROUND WATER FOR IRRIGATION IN THE BROOTEN-BELGRADE AREA, WEST-CENTRAL MINNESOTA,
Geological Survey, Washington, D. C.
W. A. Van Voast.

Available from Sup Doc, GPO, Wash, D C 20402 - \$1.25. Geological Survey Water-Supply Paper 1899-E, 1971. 24 p, 9 fig, 2 plate, 4 tab, 16 ref.

Descriptors: *Groundwater, *Water supply, *Irrigation, *Withdrawal, *Minnesota, Water yield, Water quality, Aquifers, Aquifer characteristics, Pumping, Hydrologic data, Data collections, Boreholes, Surveys, Chemical analysis, Water analysis, Analog models, Water resources development.
Identifiers: *Groundwater resources, *Groundwater hydrology.

Water for irrigation is needed to improve crop yields from sandy soils in the Brooten-Belgrade area in Minnesota. Groundwater supplies of sufficient quantity and suitable quality for irrigation are available in much of the area. Quaternary glacial drift, as much as 300 feet thick, is underlain by Precambrian crystalline rocks and possibly by Cretaceous sedimentary rocks. Sand and gravel aquifers are buried at various depths in the drift. One buried aquifer, possibly capable of high yields, is within 250 feet of the land surface in the vicinity of Belgrade. Glacial outwash comprises the upper part of the drift in most of the project area and is locally more than 100 feet thick. The outwash is made up of crossbedded sand and gravel that is interbedded in places with silt and clay deposits and has a saturated thickness of as much as 65 feet. Locally, the transmissivity of the surficial aquifer is as much as 60,000 gallons per day per foot, but elsewhere is generally less than 30,000 gallons per day per foot. The aquifer should yield more than 300 gallons per minute and locally more than 1,000 gallons per minute to individual wells in much of the northern and southwestern parts of the area. Recharge to the surficial aquifer is almost entirely from precipitation. Significant groundwater losses occur as base flow and underflow, and through evaporation and transpiration. Water in the buried and surficial aquifers is of the calcium magnesium bicarbonate type and is of suitable quality for irrigation. (Woodard-USGS)
W72-02071

SUBSURFACE DISPOSAL OF LIQUID INDUSTRIAL WASTES IN ALABAMA-A CURRENT STATUS REPORT,
Alabama Geological Survey, University.
For primary bibliographic entry see Field 05E.
W72-02075

SUBSURFACE STORAGE AND DISPOSAL IN ILLINOIS,
Illinois State Water Survey, Urbana. Hydrology Section.
For primary bibliographic entry see Field 05E.
W72-02076

FEASIBILITY OF RECHARGING TREATED SEWAGE EFFLUENT INTO A DEEP SAND-STONE AQUIFER,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 05D.
W72-02077

PESTICIDE CONTAMINATION OF A SHALLOW BORED WELL IN THE SOUTHEASTERN COASTAL PLAINS,
South Piedmont Conservation Research Center, Watkinsville, Ga.
For primary bibliographic entry see Field 05B.
W72-02078

GASOLINE POLLUTION OF A GROUND-WATER RESERVOIR -- A CASE HISTORY,
Los Angeles Dept. of Water and Power, Calif.
For primary bibliographic entry see Field 05B.
W72-02079

PETROLEUM CONTAMINATION OF GROUND WATER IN MARYLAND,
Maryland State Dept. of Water Resources, Annapolis. Groundwater Management Div.
For primary bibliographic entry see Field 05B.
W72-02080

GROUND-WATER POLLUTION POTENTIAL OF A LANDFILL ABOVE THE WATER TABLE,
Pennsylvania State Univ., University Park. Dept. of Geosciences.
For primary bibliographic entry see Field 05B.
W72-02081

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Groundwater Management—Group 4B

A PRELIMINARY EVALUATION OF HYDROLOGIC CONDITIONS OF THE LAKE-LAND RIDGE AREA OF POLK COUNTY, FLORIDA,

Geological Survey, Tallahassee, Fla.

A. F. Robertson.

Geological Survey Open-file Report 71007, 1971.

8 fig, 4 tab, 42 ref.

Descriptors: *Water resources development, *Groundwater, *Lakes, *Hydrologic data, *Florida, Reviews, Aquifers, Aquifer characteristics, Hydrogeology, Withdrawal, Water yield, Water quality, Groundwater recharge, Water level fluctuations, Water wells, Observation wells, Pumping, Water users, Chemical analysis.

Identifiers: *Polk County (Fla).

Hydrologic conditions of the Lakeland Ridge area of Polk County, Florida are evaluated. The Lakeland ridge area covers about 300 square miles in northwest Polk County. The rapid growth of this area has resulted in an increase in groundwater withdrawals such that in 1968 about 67.5 mgd was pumped to satisfy the demands of municipal, irrigation, and industrial users. The Floridian aquifer is the major source of water in the ridge area and occurs within limestones of Eocene to Miocene ages. The Suwannee Limestone, which underlies most of the Lakeland ridge area constitutes the uppermost part of the Floridian. Recharge within the study area is about 72 mgd, which is only slightly more than estimates of minimum withdrawals for 1968. Lakeland maintains 27 wells throughout the city and in nearby communities from which public water supplies are drawn. The water quality is generally good and meets water-quality standards for interstate carriers established by the U.S. Public Health Service, 1962. However, most wells yield water that is hard, and some water that contains objectionable quantities of hydrogen sulfide. (Woodard-USGS)

W72-02086

GROUND-WATER EXPLORATION, BEAVER CREEK VALLEY NEAR KENAI, ALASKA,

Geological Survey, Anchorage, Alaska.

G. S. Anderson.

Geological Survey Open-file Report, June 1971. 27 p, 13 fig, 4 tab.

Descriptors: *Groundwater, *Water resources development, *Water wells, *Hydrologic data, *Alaska, Water yield, Water quality, Chemical analysis, Data collections, Drill holes, Aquifers, Aquifer characteristics, Hydrogeology, Water supply, Pumping, Drawdowns, Hydrography, Groundwater recharge, Withdrawal.

Identifiers: *Groundwater resources, Kenai (Alaska), Groundwater hydrology.

Groundwater resources were investigated for the city of Kenai, Alaska including an analysis of groundwater potential in the vicinity of Kenai and a test-drilling program in the Beaver Creek valley near Kenai. As a result of the test drilling, a groundwater source was located and a successful production well was drilled. The Kenai area is underlain by unconsolidated stratified sedimentary deposits of glacial origin. The units include drift, outwash-plain deposits, coastal-plain deposits, deltaic deposits, abandoned-channel deposits, and alluvium. Geologic units most favorable for groundwater development within the study area include the outwash-plain deposits and the abandoned-channel deposits. On the basis of the available aquifer-test data, the city of Kenai should be able to obtain the required 650 gpm sustained average flow or 3,000 gpm for 10 hours from two or three properly spaced and constructed wells in the Beaver Creek valley. The water from all wells was of the sodium bicarbonate type and of good quality. Iron content ranged from 0.08 to 0.80 mg/liter. The water samples ranged in hardness from 1 to 95 mg/liter. Some of the samples had a slight hydrogen sulfide odor and an amber color. (Woodard-USGS)

W72-02087

TEST OF THE STROEBEL SPRING - A SUPPLEMENTARY STUDY OF THE FORT CARSON EXPANSION PROJECT, CIVIL ACTION NO. 8920, TRACT NO. 202, EL PASO COUNTY, COLORADO,

Geological Survey, Lawrence, Kans.

E. D. Jenkins.

Geological Survey Open-file Report, 1971. 16 p, 3 fig, 1 tab, 1 ref.

Descriptors: *Groundwater, *Sumps, *Pumping, *Groundwater recharge, *Colorado, Water levels, Withdrawal, Water level fluctuations, Aquifers, Alluvium, Water yield, Groundwater movement, Springs, Hydrologic data, Data collections.

Identifiers: *El Paso County (Colo).

The Stroebel Spring sump is a 40- by 60-foot excavation in the alluvium of Turkey Creek, in El Paso County, Colorado. The sump yielded 2 gallons per minute as overflow in October 1970 when it was not pumped and would have yielded about 90 gallons per minute if the pumping water level had been lowered 7 1/2 feet, or to within 1 foot of the bottom. The rate of groundwater inflow to the sump will vary from slightly more to much less than 90 gallons per minute, depending upon the amount of recharge available to the groundwater reservoir from precipitation. The Stroebel Spring sump will not sustain a yield of 90 gallons per minute during periods of deficient precipitation and runoff. (Woodard-USGS)

W72-02088

PROSPECTS OF UTILIZING GROUNDWATER OF THE SOUTHEASTERN PART OF WEST SIBERIA (PERSPEKTYV ISPOL'ZOVANIYA PODZEMNYKH VOD YUGO-VOSTOCHNOY CHASTI ZAPADNOY SIBIRI),

Novosibirsk Territorial Geological Administration (USSR).

S. G. Beyron, and Ye. V. Mikhaylova.

In: Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna; Izdatel'stvo 'Nauka', Novosibirsk, USSR, p 183-191, 1970. 2 tab.

Descriptors: *Hydrogeology, *Groundwater, *Groundwater movement, *Aquifers, *Aquifer characteristics, Water quality, Water storage, Transmissivity, Specific yield, Potentiometric level, Drawdown, Petrography, Rocks, River basins, Streamflow, Discharge (Water), Geologic time, History.

Identifiers: *USSR, *West Siberia, Omsk Oblast, Novosibirsk Oblast, Tomsk Oblast, Altay Territory, Groundwater occurrence, Groundwater storage, Mineralization.

Groundwater plays a vital role in the national economy of Siberia and is often the deciding factor in the development of industrial and agricultural production. The total groundwater storage computed for the southeastern part of West Siberia is 542.2 cu m/sec and is distributed as follows: Omsk Oblast — 11.6 cu m/sec; Novosibirsk Oblast — 129.6 cu m/sec; Tomsk Oblast — 295.8 cu m/sec; and Altay Territory — 105.2 cu m/sec. Most of the groundwater available is of high quality and meets drinking-water standards. Two basins in the area of the Irtysh-Upper Ob and Middle Ob were examined to study the occurrence, movement, storage, and quality of groundwater, and the character, distribution, and extent of aquifers. Water bearing formations, arranged according to geologic age, are described in terms of the lithology, thickness, and structure of rock formations of the area. (Josefson-USGS)

W72-02102

EFFECT OF WATER LOSSES FROM IRRIGATION CANALS ON GROUNDWATERS OF THE ALEYSK IRRIGATION SYSTEM (VLIYANIYE POTER' VODY IZ OROSITEL'NYKH KANALOV NA GRUNTOVYYE VODY ALEYSKOV OROSITEL'NOY SISTEMY),
For primary bibliographic entry see Field 03F.

W72-02103

HYDROGEOLOGIC FACTORS INFLUENCING WELL YIELDS IN FOLDED AND FAULTED CARBONATE ROCKS IN CENTRAL PENNSYLVANIA,

Pennsylvania State Univ., University Park. Mineral Conservation Section.

S. H. Siddiqui, and R. R. Parizek.

Water Resources Research, Vol 7, No 5, p 1295-1312, October 1971. 11 fig, 6 tab, 31 ref. OWRR A-005-PA (3).

Descriptors: *Water yield, *Hydrogeology, *Aquifer characteristics, *Pennsylvania, *Carbonate rocks, Karst, Permeability, Fractures (Geology), Solubility, Porosity, Transmissivity, Specific capacity.

Identifiers: Well productivity.

Hydrogeologic factors influencing well yields in folded and faulted Cambro-Ordovician carbonate rocks and shales were investigated in central Pennsylvania. Productivity values were obtained from 80 wells. Fracture-trace wells were more productive than not located on fracture traces. Accidentally located wells were as productive as intentionally located wells because the accidentally located wells were clustered in more productive rocks. The success ratio of accidentally locating a fracture trace well is 4:6. Wells in sandy dolomites and coarse-grained dolomites were the best producers; wells in valley bottoms were more productive than those in valley walls and uplands; anticlinal wells were better producers than synclinal wells; and wells in beds dipping at less than 15 degrees had higher yields than others. The Upper Sandy dolomite member and the Nittany dolomite have similar aquifer characteristics, which are significantly different from those of Bellefonte dolomite, limestones, and shales. (Knapp-USGS)

W72-02115

OPTIMIZATION IN MUNICIPAL WATER SUPPLY SYSTEM DESIGN,

Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.

For primary bibliographic entry see Field 06A.

W72-02125

IRRIGATION PLANNING 2: CHOOSING OPTIMAL ACREAGES WITHIN A SEASON,

Montana State Univ., Bozeman. Dept. of Economics and Agricultural Economics.

For primary bibliographic entry see Field 06A.

W72-02130

REQUIREMENT FOR THE CAPPING OF CERTAIN ARTESIAN WELLS.

For primary bibliographic entry see Field 06E.

W72-02186

THE USE OF CHEMICAL HYDROGRAPHS IN GROUNDWATER QUALITY STUDIES,

Harshbarger and Associates, Tucson, Ariz.

For primary bibliographic entry see Field 05A.

W72-02225

RENOVATING SEWAGE EFFLUENT BY GROUND-WATER RECHARGE,

Agricultural Research Service, Phoenix, Ariz.

Water Conservation Lab.

For primary bibliographic entry see Field 05D.

W72-02226

RECHARGING THE OGALLALA FORMATION USING SHALLOW HOLES,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources; and Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering.

M. J. Dvoracek, and S. H. Peterson.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-

American Water Resources Association and the Hydrology Section-Arizona Academy of Science,

April 22-23, 1971, Tempe, Vol 1, p 245-259, 1971.

5 fig, 1 tab, 15 ref.

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B—Groundwater Management

Descriptors: *Groundwater recharge, *Aquifers, *Observation wells, *Hydrogeology, *Shallow wells, Texas, Great Plains, Semiarid climates, Aquifer characteristics, On-site data collections, Sediments.

Identifiers: *Soil piping, *Ogallala aquifer.

The southern bed of the Ogallala aquifer is hydrologically isolated from all outside areas of recharge, requiring local precipitation for all natural recharge. Current withdrawals are so much greater than natural recharge that it appears that artificial recharge affords the only means of establishing at least a pseudo-balance. A number of observation wells were drilled at Texas Tech University, and subsequently capped until recharge water became available. The initial recharge was 2.5 af over 12 days, at a rate of 120 gpm for about the first day, after which 60 gpm was relatively constant. Approximately 1 month later, 1.2 af were recharged over 3 days at rates ranging over 140-90 gpm. It became evident that a cavity was present at the bottom of the hole being recharged. On a later recharge occasion, the cavity seemed to have enlarged. During a period of 2 years more than 28 af of surface runoff water have been recharged through the shallow hole with increases in recharge rates for each subsequent recharge period. The nature of this phenomenon and the cavities are not understood. This may represent the long sought after answer to recharge of the aquifer, but much more extensive research needs to be done. (See also W72-02212) (Casey-Arizona) W72-02227

MANAGEMENT OF ARTIFICIAL RECHARGE WELLS FOR GROUNDWATER QUALITY CONTROL,

Arizona Univ., Tucson. Water Resources Research Center.

For primary bibliographic entry see Field 05G.

W72-02228

COLLECTIVE UTILITY: A SYSTEMS APPROACH FOR THE UTILIZATION OF WATER RESOURCES,

Arizona Univ., Tucson. Dept. of Systems Engineering.

E. Dupnick, and L. Duckstein.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 313-325, 1971. 5 ref.

Descriptors: *Model studies, *Optimization, *Decision making, *Groundwater, *Economic impact, Mathematical models, Arid lands, Arizona, Economic efficiency, Economic prediction, Water users, Competing uses, Systems analysis.

Identifiers: *Collective utility.

In the semiarid southwestern U.S. where competition for water is fierce between competing users, no regional agency controls water allocation, and as a result, much court litigation ensues. This paper attempts to develop a model for optimal allocation of water resources and to apply the model to a specific case study. In November 1969, the largest farming interest in the Sahuarita-Continental area near Tucson filed a court suit seeking first to reduce the amount of groundwater used by 4 nearby copper mines, and then to allocate the water more evenly among various interests in the area. The farming interest maintained that the mines' drawdown on the groundwater table would soon deplete the supply to the point where agriculture would become impossible. The model utilizes the concept of collective utility which postulates the existence of an Economic Decision Maker (EDP). To get around the problem of determination of net revenue functions, the theory compares the relative desirability of neighboring economic states. The EDP has the power to impose groundwater-use taxes in such a way as to maximize overall growth of collective utility in the Sahuarita-Continental area, taking into account the externalities of the

resource consumption. The mathematical analysis is presented in detail. (See also W72-02212) (Casey-Arizona) W72-02232

4C. Effects on Water of Man's Non-Water Activities

ENHANCEMENT OF ECOLOGIC AND AESTHETIC VALUES OF WATER ASSOCIATED WITH INTERSTATE HIGHWAYS,

Massachusetts Univ., Amherst.

K. L. Bergstrom, P. R. Dommel, J. C. Moulton, and

W. E. Rogers.

Available from the National Technical Information Service as PB-204 894, \$3.00 in paper copy, \$0.95 in microfiche. Massachusetts University Water Resources Research Center Publication No 19, (1971), 114 p, 7 fig, 2 tab, 269 ref, 2 append. OWRR-B-010-MASS (2).

Descriptors: *Wetlands, *Road construction, *Standing waters, *Highway beautification, *Water resources development, Recreation, Wildlife, Ecology, Aesthetics, Scenic highways.

The ecological and aesthetic characteristics of water resources formed or altered during the construction of major highways is examined. The objectives of the study were: (1) to develop design and management criteria for protecting coastal wetlands and developing water impoundments in conjunction with Federal Interstate Highway construction in relation to wildlife and fish habitat improvement in Massachusetts and southern New England, (2) to develop visual-aesthetic design and management criteria for such impoundments and wetlands in relation to highway beautification; and (3) to examine existing statutory, institutional and administrative provisions and their application and improvement in order to create a procedure for implementing the design and management proposals in the Interstate Highway program. In building highways, engineers have frequently created new wetlands by digging borrow pits which subsequently fill with water. Impoundments of streams and rivers have also resulted in manmade wetlands. With forethought and planning these new wetlands could enhance the environment of the highway corridor, rather than detract from it. (Woodard-USGS) W72-01698

EFFECT OF URBANIZATION ON STORM WATER PEAK FLOWS,

Praca Da Alegria, Lisbon (Portugal).

Pedro C. C. DaCosta.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA 2, April 1970, p 187-193, 1 fig, 3 ref.

Descriptors: *Urbanization, *Storm runoff, *Drainage, Subsurface drainage, Runoff forecasting, Rainfall-runoff relationships, Hydrographs, Rainfall intensity, Storm drains, Infiltration, Percolation, Permeability, Flow rates, Velocity.

Urbanization of areas has effected the amount of water which runs off after rain has fallen. In the rational formula $Q = CiA$, where Q = runoff volume, C = coefficient of permeability, i = rainfall intensity, and A = area upon which the rain fell, several factors were changed. The most obvious change in the formula is the change in permeability of the receiving area. With paving and rooftops accounting for nearly all available area the coefficient of runoff approaches unity. Another change is the installation of subsurface lined sewers, as opposed to natural channels. The time of travel for the water to exit the area is shortened because of the higher velocities reached in sewer pipes. Starting with a basic, synthetic, or characteristic hydrograph of a natural watershed and using true rational relationships to relate rainfall and runoff, it is possible to

modify the hydrograph and the corresponding peak discharge according to the degree of urbanization, although practical applications may require much experimental data, as well as control with other methods. (Lowry-Texas) W72-01857

INVESTIGATION OF THE EFFECTS OF URBANIZATION ON PRECIPITATION TYPE, FREQUENCY, AREAL AND TEMPORAL DISTRIBUTION,

Rutgers-The State Univ., New Brunswick, N. J. Dept. of Meteorology.

For primary bibliographic entry see Field 02B.

W72-01982

CONTROL OF SEDIMENTS RESULTING FROM HIGHWAY CONSTRUCTION AND LAND DEVELOPMENT,

Environmental Protection Agency, Washington, D.C. Office of Water Programs.

For primary bibliographic entry see Field 02J.

W72-02106

4D. Watershed Protection

'S STREET CHANNEL IMPROVEMENTS, NEEDLES, SAN BERNARDINO COUNTY, CALIFORNIA, ENVIRONMENTAL STATEMENT (ENVIRONMENTAL STATEMENT).

Army Engineer District, Los Angeles, Calif.

For primary bibliographic entry see Field 08A.

W72-01828

ECONOMIC EVALUATION OF SOME WATERSHED MANAGEMENT ALTERNATIVES ON FOREST LAND IN WEST VIRGINIA,

Forest Service, Columbus, Ohio. Northeastern Forest Experiment Station; and Forest Service, Parsons, West Va. Northeastern Forest Experiment Station.

For primary bibliographic entry see Field 04A.

W72-02146

LIMITATION ON DIVERSION FROM THE WATERSHED: RIPARIAN ROADBLOCK TO BENEFICIAL USE,

For primary bibliographic entry see Field 06E.

W72-02149

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

POTENTIOMETRIC TECHNIQUES FOR MONITORING IONS INVOLVED IN WATER POLLUTION,

Missouri Univ., Columbia. Dept. of Chemistry.

S. E. Manahan, M. J. Smith, D. Alexander, and P. Robinson.

Available from the National Technical Information Service as PB-204 890, \$3.00 in paper copy, \$0.95 in microfiche. Missouri Water Resources Research Center, Columbia, Completion Report, Aug 1, 1971. 26 p, 4 fig, 2 tab, 4 ref. OWRR-B-040-MO (1).

Descriptors: *Pollutant identification, *Nitrogen, Electrochemistry, Trace elements, Heavy metals, Electrodes, Nitrates, Algae, Copper, Ions, Ion transport.

Identifiers: Potentiometry, Cadmium ions, Copper ions, Oocysts.

The use of ion-selective electrodes, particularly the nitrate electrode, was explored for the analysis of ionic species in natural aquatic systems. Attempts to compensate quantitatively for the effects of in-

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Identification of Pollutants—Group 5A

terferring ions were unsuccessful. Ion-selective electrodes should not be used, therefore, when substantial interferences are present. Standard addition is generally the preferred technique with ion-selective electrodes. The cadmium electrode was used to determine the formation constant of the citrate complex of cadmium ion. The log of the formation constant was found to be 3.76 plus or minus 0.04, 95% confidence level. Copper ion deficiency in algal cultures was studied and correlated with copper ion activity as measured by the copper electrode. It was found that a minimum level of approximately 40 parts per billion of copper was required for optimum growth of a culture of *Oocystis*. The growth of the algae at minimum copper levels could be suppressed by the addition of chelating agent.

W72-01693

DESIGN AND CONSTRUCTION OF A SHALLOW WATER SEDIMENT CORE SAMPLER, Wisconsin Univ., Madison. Water Resources Center.

T. C. Daniel, and G. Chesters.

Environmental Letters, Vol. 1, No. 3, p 225-228, 1971. 1 fig, 2 ref. OWRR B-016-WIS (13).

Descriptors: Design, *Cost, Operation, *Sampling, *Cores, *Sediments.

Identifiers: *Sampler.

A shallow water core sampler was constructed from plumbing materials and extruded plexiglas tubing. Construction of the sampler is simple and the total cost of materials is approximately \$35. The sampler is capable of taking cores at water depths up to 6m and by modification at greater depths. The total weight of the sampler is 12 kg, it is easy to operate and can be used for sediments ranging from sand to highly organic clayey material. Core samples varying in length and cross-sectional area can be obtained by changing the dimensions of the plexiglas tube.

W72-01738

PHYTOPLANKTONIC NITROGEN AS AN INDEX OF CULTURAL EUTROPHICATION, Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.

For primary bibliographic entry see Field 05C.

W72-01780

BIOLOGICAL INDICES OF WATER POLLUTION WITH SPECIAL REFERENCE TO FISH POPULATION, Public Health Service, Cincinnati, Ohio; and Oregon State Coll., Corvallis. Dept. of Fish and Game Management.

For primary bibliographic entry see Field 05C.

W72-01791

VALUE OF THE BOTTOM SAMPLER IN DEMONSTRATING THE EFFECTS OF POLLUTION ON FISH-FOOD ORGANISMS AND FISH IN THE SHENANDOAH RIVER, Fish and Wildlife Service, Kearneysville, W. Va. For primary bibliographic entry see Field 05C.

W72-01800

CHEMICAL COMPOSITION OF ALGAE AND ITS RELATIONSHIP TO TASTE AND ODOR, Michigan Univ., Ann Arbor. School of Public Health.

Gerard A. Rohlich, and William B. Saries.

In: Biology of water pollution, p 232-235. Compiled by W. M. Ingram, L. E. Keup, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967. 4 tab, 12 ref.

Descriptors: *Water pollution sources, *Algae, *Taste, *Odor, *Amino acids, Potable water, Actinomycetes, Plant growth, Decomposing organic matter, Chemical analysis, Proteins, Bacteria.

Identifiers: Odoriferous products, Organisms' odors.

The objectionable taste and odor of drinking water is largely due to decomposition of nucleo-proteins, phospho-proteins, lipids, and other tissue constituents of aquatic biota, particularly algae in association with bacteria and actinomycetes. The odor of drinking water, ranging from vile stench and fishy or cod-liver oil to earthy, sweet, grassy and aromatic, is imparted by Diatomaceae, Cyanophyceae, Chlorophyceae, Actinomycetes, and Protozoa. The odor may also originate from bacterial action liberating ammonia from amino-acids and producing various alcohols. Odor may be intensified by decomposition of algae, especially following their destruction by chlorination, copper sulfate, and similar eradicating treatments. (See also W72-01786) (Wilde-Wisconsin) W72-01812

DETERMINING CHLORINE DIOXIDE AND CHLORITE, Newcastle and Gateshead Water Co., Newcastle-upon-Tyne (England).

For primary bibliographic entry see Field 05F.

W72-01873

STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, Michael J. Taras.

American Public Health Association: New York, N. Y., 1971. 13th Edition. 874p.

Identifiers: Bacteria, Examination, Methods, Pollutants, Radioactivity, Standard, Waste, Water.

This edition, prepared jointly by the American Public Health Association, American Water Works Association and Water Pollution Control Federation, begins with a brief history of the manual since 1905. All methods are 'standard' unless indicated 'tentative,' included under hearings: physical and chemical examination of natural and treated waters in the absence of gross pollution; physical, chemical and bioassay examination of polluted waters, wastewaters, effluents, bottom sediments and sludges; examination of water and wastewater for radioactivity; bacteriological examination of water to determine its sanitary quality; identification of iron and sulfur bacteria; and biological sampling and analysis. The book retains the general introduction with its information concerning proper execution of the procedures described in the various parts of the manual. The section dealing with quality of the required chemical reagents was expanded; the number of common acid and alkali concentrations was maintained at a practical minimum. Each part of the manual contains an introduction to applications, completed discussions of each procedure, selection of methods, sampling and storage, general discussion and interference and preparation of reagents. Notes are also included on sensitivity, precision and accuracy of the methods described. Sample methods added in this edition include new colorimetric methods including reductions for nitrate, iodometric methods for residual chlorine, equipment for single and multichannel gamma spectrum analysis, an emphasis on microscopic identification of iron and sulfur bacteria and methods for the collection of plankton, periphyton, macrophyton, macroinvertebrates, fishes and other organisms with new figures and black and white plates. Illustrations are indexed, a list of taxonomic references is given and a subject index completes the book.—Copyright 1971, Biological Abstracts, Inc.

W72-01888

A PARTIAL CHECKLIST OF FLORIDA FRESH-WATER ALGAE AND PROTOZOA WITH REFERENCE TO MCLOUD AND CUE LAKES, Florida Univ., Gainesville. Dept. of Environmental Engineering.

James B. Lackey, and Elsie W. Lackey.

Available from the National Technical Information Service as PB-179 071, \$3.00 in paper copy, \$0.95

in microfiche. Water Resources Research Center, Publication No. 3, Bulletin Series No. 131, Florida Engineering and Industrial Experiment Station, Vol 21, No 11, Nov 1967, p 1-28, 16 tab, 24 ref. OWRR B-004-Fla (7). FWPCA Grant 16010 DOD.

Descriptors: *Aquatic algae, *Protozoa, *Florida, *Eutrophication, Aquatic microorganisms, Trophic level. Identifiers: Cue Lake (Florida), McCloud Lake (Florida).

Florida is a land where there are many kinds of fresh water and many kinds of climate. Since there is usually a distinct rainy season, blooms tend to be prevalent during or just after this season. In eutrophic waters, blooms may occur anytime. All these matters make Florida waters an extremely valuable research area for the microbiologist. The most intensive work has been done on two lakes near Melrose, Florida: Cue Lake and McCloud Lake. Cue Lake became subject to routine fertilization since 1967. In addition to these two lakes, 33 other locations were sampled. The report contains a list of occurring species. A wide spectrum of algae and protozoa were identified emphasizing that most of these organisms are cosmopolitan. Many of them do not cross broad ecological boundaries but narrow boundaries and each species has a maximum set of conditions under which it attains maximum numbers. It is useful to recognize the species we see because by correlating numbers of individuals with known conditions we may reach conclusions regarding taxonomic and physiological relationships.

W72-01993

MERCURY POLLUTION: MICHIGAN'S ACTION PROGRAM, Michigan Water Resources Commission, Lansing.

For primary bibliographic entry see Field 05B.

W72-01995

NATURAL RELATIONSHIPS OF INDICATOR AND PATHOGENIC BACTERIA IN STREAM WATERS, Detroit Univ., Mich. Dept. of Biology.

For primary bibliographic entry see Field 05B.

W72-01996

MICROWAVE RADIOMETRIC DETECTION OF OIL SLICKS, Aerojet-General Corp., El Monte, Calif. Microwave Div.

D. C. Meeks, D. P. Williams, R. M. Wilcox, and A. T. Edgerton.

Available from National Technical Information Service, Springfield, Va., 22151 as AD-728 51, \$3.00 paper copy, \$0.95 in microfiche. Final Report No 1335-2, March 1971. 91 p, 42 fig, 8 tab, 34 ref, append. 714104/A/002, DOT-CG-93, 228-A.

Descriptors: *Water pollution sources, *Oily water, *Surface waters, *Pollutant identification, *Microwaves, Analytical techniques, Remote sensing, Radiation, Aircraft, Electromagnetic waves, Oceans, Bays, Oil-water interfaces, Oil industry, Tracking techniques.

Identifiers: *Oil spills.

Two years of research were conducted to determine the feasibility of using microwave radiometry for the detection, identification, and surveillance of oil pollution. The research was divided into theoretical studies, laboratory experiments, and airborne measurements. Theoretical studies consisted of a review of contemporary theory concerning parameters that influence microwave emission from both unpolluted and oil-covered seas. Laboratory investigations confirmed results obtained from earlier studies and established the response characteristics of the 3.2-mm sensor to continuous oil films. Airborne measurements of controlled spills off the Southern California Coast were performed with dual-polarized 3.2- and 8.1-mm sensors

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification of Pollutants

oriented with a forward antenna viewing angle 45 deg above nadir. Pollutants used for the tests included No. 2 diesel fuel, 26.1 and 21.6 API gravity crude oils, and 9.7 API gravity fuel oil. Significant microwave brightness temperature oil slick signatures were noted for a wide range of ocean conditions and oil film thickness. Based on the experimental results a passive microwave imaging system configuration was recommended for oil pollution surveillance. (Woodard-USGS)
W72-02024

IODINE AND ALGAE IN SEDIMENTARY ROCKS ASSOCIATED WITH IODINE-RICH BRINES.
Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.
For primary bibliographic entry see Field 02K.
W72-02073

COMPARISON OF PLANT WATER QUALITY TO PROPOSED WATER QUALITY STANDARD,
Sunflower Army Ammunition Plant, Lawrence, Kans.
For primary bibliographic entry see Field 05F.
W72-02082

OPTICAL FOURIER TRANSFORM TECHNIQUE FOR MEASURING SEDIMENT CONCENTRATION,
Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
For primary bibliographic entry see Field 02J.
W72-02158

ARTHROBACTER LUTEUS NOV. SP. ISOLATED FROM BREWERY SEWAGE,
Kirin Brewery Co. Ltd., Takasaki (Japan). Research Lab.
Tatsuhiko Kaneko, Kunpei Kitamura, and Yasushi Yamamoto.
Rep Res Lab Kirin Brew Co Ltd. 12. 9-16. Illus. 1969.
Identifiers: *Actinomycetaceae*, *Arthrobacter-Luteus*, *Brewery*, *Corynebacteriaceae*, *Intermediate*, *Isolated*, *Seawage*, *Species*.

A Group of bacteria isolated from brewery sewage was studied taxonomically. They were gram-positive, facultatively anaerobic, pleomorphic, branching, non-motile, non-sporulating, non-acid-fast and catalasepositive rods (0.6 - 1.0 x 0.8 - 10.0 micro). They formed cystites and showed bending-type cell division. They produced a yellow pigment and reduced nitrate, hydrolyzed starch liquefied gelatin and produced acids from various carbohydrates. These characteristics were compared with those of 18 strains of related microorganisms. The isolates seemed to belong to the genus *Arthrobacter*, but no corresponding species was found in the taxa appearing in *Bergen's Manual* (7th Ed.). The name *Arthrobacter luteus* was, therefore, proposed for these isolates. While the new species was in accord with those of the genus *Arthrobacter* in basic characteristics, it also had similarities to some species of the genera *Nocardia*, *Cellulomonas*, *Microbacterium*, and *Corynebacterium*. These observations suggested that the species occupied an intermediate position between the families *Corynebacteriaceae* and *Actinomycetaceae*.—Copyright 1971, Biological Abstracts, Inc.
W72-02182

CHARACTERIZATION AND IDENTIFICATION OF SPILLED RESIDUAL FUEL OILS BY GAS CHROMATOGRAPHY AND INFRARED SPECTROPHOTOMETRY,
Environmental Protection Agency, Cincinnati, Ohio. Analytical Quality Control Lab.
F. K. Kawahara.
Paper presented at the Third Regional (Northeast) American Chemical Society Meeting, Oct 11-13, 1971 at Buffalo, N.Y., June 1971. 25 p, 14 fig, 6 tab, 16 ref.

Descriptors: *Oil, *Gas chromatography, *Analytical techniques, Oily water, Water pollution sources, Industrial wastes, Fuels, Taste, Odor, Pollutants, Oil wastes, Spectroscopy.
Identifiers: *Infrared spectrophotometry, Heavy residual fuel oils, Weathered oils.

Oil discharges and spills from industrial plants and ships impart unpleasant taste and odor to water and to game fish and fowl, as well as affect the amenities of beach and recreational facilities. For enforcement actions, it has been useful not only to identify the source of oil spills in the streams, but also to characterize first the petroleum product involved. Methods developed in the last two years at the Analytical Quality Control Laboratory are described. A powerful aid for the characterization of fuel oil products is stressed. Identify with gas chromatographic and infrared data are given and comparisons are made in the absence of extremely expensive analytical equipment. (EPA abstract)
W72-02196

PRELIMINARY RESEARCH IN THE LABORATORY ON EXPERIMENTAL BRACKISH ECOSYSTEMS,
J. C. Lacaze, C. Hallopeau, and M. Voigt.
Bull Mus Natl Hist Natur (Paris). 41 (5): 1278-1289. Illus. 1969.

Descriptors: Algae, Brackish, Ecosystems, Fauna, Flora, Laboratory, Minerals, Pollution.

Four aquatic ecosystems were studied starting from algae, sediment, and water taken from a brackish marsh of the Arcachon region. The important thing is to obtain systems possessing characteristic structure, behavior and replicability. The experiment lasted a year (July 1966 - Aug. 1967) during which time fauna, flora, nitrates, phosphates, and alkalinity were analyzed. Special importance was given to the micro-flora of diatoms developing on the immersed substrata. The experimental ecosystems were studied as biological material for pollution studies.—Copyright 1971, Biological Abstracts, Inc.
W72-02203

THE USE OF CHEMICAL HYDROGRAPHS IN GROUNDWATER QUALITY STUDIES,
Harshbarger and Associates, Tucson, Ariz.
K. D. Schmidt.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 211-223, 1971. 4 fig, 6 ref.

Descriptors: *Nitrates, *Hydrographs, *Groundwater, *Chemical analysis, *Water chemistry, California, Semiarid climates, Chlorides, Seasonal, Hydrogeology, Water quality control, Sewage lagoons, Pollutant identification, Hydrograph analysis, Water wells, Water pollution sources.
Identifiers: *Chemical hydrographs.

High nitrates in drinking water are significant in relation to an infant disease, methemoglobinemia, and the U.S. Public Health Service has set a limit of 45 ppm for human consumption. This paper illustrates how chemical hydrographs were used in a study of nitrates in the groundwater of the Fresno-Clovis Metropolitan Area (F.C.M.A.) of semiarid central California. The area comprises about 145 square miles, with a population of 310,000. Urban water use is entirely derived from wells, whereas the surrounding agriculture relies on surface and ground water. In 1965, the California Department of Water Resources noted nitrate concentrations in the F.C.M.A. were exceeding the safe limit. A number of sources of error in chemical analyses of water quality are noted. A measure of the accuracies of analyses and a method of double-checking anomalous results is furnished by plotting chemical hydrographs of individual wells. Seasonal changes in nitrate were consistent for many parts of the area, and were related to hydrogeologic factors and parameters directly affecting nitrification. Nitrate

hydrographs were monitored by chloride hydrographs. The highest nitrate concentrations were in the shallower parts of the aquifer, and well deepening and changes in water level, pumping patterns and recharge rates complicated interpretations. However, the hydrographs helped to pinpoint the source of nitrate in areas where several possible sources were present. (See also W72-02212)
W72-02225

5B. Sources of Pollution

EFFECTS OF RECENT AND PAST PHOSPHATE FERTILIZATION ON THE AMOUNT OF PHOSPHORUS PERCOLATING THROUGH SOIL PROFILES INTO SUBSURFACE WATERS,
Missouri Univ., Columbia. Dept. of Agronomy.
For primary bibliographic entry see Field 02G.
W72-01691

WATER GEOCHEMISTRY OF MINING AND MILLING RETENTION IN THE 'NEW LEAD BELT' OF SOUTHEAST MISSOURI,
Missouri Univ., Rolla. Water Resources Research Center.

Ernst Bolter, and Nicholas H. Tibbs.

Available from the National Technical Information Service as PB-204 889, \$3.00 in paper copy, \$0.95 in microfiche. Completion Report Sept 1971. 34 p, 9 fig, 12 tab, 4 ref. OWRR-A-032-MO (1).

Descriptors: Water pollution, *Heavy metals, Retention, *Mine water, Geochemistry, Missouri, *Copper, *Mine wastes, Path of pollutants.
Identifiers: *Lead, *Zinc, *Retention ponds, New Lead Belt (Mo).

The heavy metal content and other geochemical data of the mine and mill waters of two mining operations in the 'New Lead Belt' of southeastern Missouri were determined and the efficiency of retention ponds in reducing high metal concentrations was investigated. The mine waters from two mines of this mining district, which is the largest lead producer in the world, showed a heavy metal content of less than 6 ppb copper, 66 ppb lead and 37 ppb zinc. They do not constitute a major source of pollution to the unspoiled streams of the region. The heavy metal content from the mill effluents was reduced to values similar to mine water, when the pond sizes were large enough. This refers to effluent flows of up to 10,000 gallons per minute and pond sizes of about 20 acres and up to twenty feet of depths. When the pond size was reduced to about 6 acres, copper and lead concentrations were still reduced sharply, but high zinc concentrations were lowered only slightly. The concentrations of calcium, magnesium, sodium and potassium and pH of the mine water are similar to their concentrations in the streams. However, their concentrations are several times higher in the mill water. These elements can therefore be used to trace mine water in the streams. High zinc concentrations in streams caused by mill water are sharply reduced within 4 miles of stream flow. The retention ponds are not entirely efficient in preventing transport of metal rich rock flour into the streams.
W72-01692

MOVEMENT AND ADSORPTION OF PESTICIDES IN STERILIZED SOIL COLUMNS,
Florida Univ., Gainesville. Water Resources Research Center.

R. S. Mansell, and L. C. Hammond.

Available from the National Technical Information Service as PB-204 644, \$3.00 in paper copy, \$0.95 in microfiche. Florida Water Resources Research Center, Gainesville, Publication No 15, Aug 9, 1971. 63 p, 24 fig, 4 tab, 33 ref. OWRR-A-013-FLA (3).

Descriptors: *Paraquat, *Pesticide removal, Herbicides, *Adsorption, Water pollution sources,

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Sources of Pollution—Group 5B

Groundwater, *2-4-D, Soil treatment, Path of pollutants.
Identifiers: *Herbicide elution.

Rapid transport of systemic and soil sterilant herbicides in soil during periods of net water flow may decrease the effectiveness of the chemicals to control unwanted vegetation and produce undesirable pollution of the ground water. An investigation of the influence of physical-chemical soil properties upon the transport of 2,4-D and paraquat in columns of organic and sandy soils was therefore performed. These herbicides are water soluble organic chemicals which are used extensively in agriculture. The toxicant portions of 2,4-D and paraquat behave as anion and cation, respectively. Miscible displacement of aqueous solutions of these herbicides through columns of Everglades mucky peat resulted in most of the 2,4-D and all of the paraquat being removed from solution by adsorption. Limited transport of 2,4-D was observed for the same fine sands. Very small quantities of organic matter in the fine sands effectively removed paraquat from the flowing soil solution. The presence of large concentrations of KCl in the soil solution was observed to decrease the quantity of paraquat sorbed. Mathematical transfer function theory was used in connection with statistical hydrodynamics to develop a technique for analysis and prediction of herbicide elution from soil columns during miscible displacement experiments. (Morgan-Florida)
W72-01697

SALINE LAKE BASINS OF THE SOUTHERN HIGH PLAINS,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
For primary bibliographic entry see Field 02F.
W72-01752

SORPTION AND DESORPTION OF CHLORINATED HYDROCARBON PESTICIDES IN AQUATIC SEDIMENT MINERALS,
Missouri Univ., Rolla. Dept. of Civil Engineering.
J. C. Huang, C. S. Liao, F. S. Chien, and L. T. Chiang.

Available from the National Technical Information Service as PB-204 706, \$3.00 in paper copy, \$0.95 in microfiche. Missouri Water Resources Research Center, Rolla, Completion Report, July 1971. 13 p., 1 tab, 14 ref. OWRR-B-037-MO (2).

Identifiers: *Pesticides, *Adsorption, *Clays, Humus, Environmental effects, Sediments, Insecticides, *Chlorinated hydrocarbon pesticides.
Identifiers: *Desorption.

The fundamental sorption and desorption reactions between selected chlorinated hydrocarbon pesticides and clay minerals were established. The effects of several important environmental factors, including pH, temperature, salt (NaCl) concentration, and organic content, on the sorption and desorption reactions were also ascertained. Results obtained reveal that organochlorine pesticides are rapidly adsorbed by clays and also retained strongly after desorption. Only small fractions of the adsorbed pesticides can be desorbed. The environmental factors of pH, temperature and salt content appear to exert no significant effect on the sorption and desorption reactions. The organic pollutants present in the water phase also bear no effect on the reactions. However, the organic humus present in the sediment phase is able to enhance the pesticide adsorption because chlorinated hydrocarbon pesticides are adsorbed in much greater quantities by organic humus than by clay minerals. Based on this study it seems promising that the sludge materials generated by waste treatment plant can be used as the pesticide carrier or diluent in future agricultural applications.
W72-01779

BIOACCUMULATION OF RADIOTRACERS THROUGH AQUATIC FOOD CHAINS,
Hanford Atomic Products Operation, Richland, Wash.

J. J. Davis, and R. F. Foster.

In: *Biology of water pollution*, p 41-46. 5 fig, 12 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Food chains, *Radiotracers, *Aquatic life, Water pollution sources, Measurement, Adsorption, Absorption, Radioactive wastes, Radioactivity effects, Radioecology, Radiosensitivity, Seasonal.
Identifiers: Columbia River (Wash.).

The maximum permissible concentrations of radioactive materials in water do not eliminate radiological hazards as organisms through the food chain may accumulate certain isotopes in concentrations far exceeding that of the water. Mechanisms of the accumulation of radiotracers by aquatic biota are described and the use of the concentration as a criterion of relationships between different species. A major fraction of most radioactive contaminants is held by organisms of the primary trophic levels. (See also W72-01786) (Wilde-Wisconsin)
W72-01792

PREDICTING EFFECTS OF DEAD ZONES ON STREAM MIXING,

Vanderbilt Univ., Nashville, Tenn. Dept. of Environmental and Water Resources Engineering.
Edward L. Thackston, and Karl B. Schnell.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA 2, April 1970. p 319-331, 5 fig, 2 tab, 13 ref.

Descriptors: *Streamflow, *Path of pollutants, *Tracking techniques, *Dispersion, Analytical techniques, Mixing, Turbulence, Flow rate, Tracers, Mathematical models, Water pollution sources.

Identifiers: Time-concentration curves, Dead zone volume fraction, Dead zone residence time fraction.

Dispersion estimations are necessary tools in predicting spread of contaminants in streams. Since streams include both the main current as well as numerous dead zones, tracer studies are usually required to determine stream model parameters. Prediction of the model parameters by mathematical methods would eliminate time consuming tracer dispersion studies. Time-concentration studies were performed on a variety of stream conditions to obtain data for mathematical derivations, and a series of equations were developed which were then checked by further studies and found to be consistent. Simple methods for evaluating the critical parameters beta and T_d , the dead zone volume fraction and the dead zone residence time fraction respectively, were formulated. The dead zones were assumed to be completely mixed in order to simplify the derivation. Further data collections are necessary to reduce the present error and expand the mathematical models to include further variables. (Lowry-Texas)
W72-01853

RELATIONSHIP BETWEEN *ESCHERICHIA COLI*, TYPE I AND ENTEROCOCCI IN WATER,

Tufts Univ., Medford, Mass. Dept. of Civil Engineering.
N. B. Hanes, C. J. O'Leary, and G. A. Delaney.
Proceedings, Industrial Waste Conference, 20th May 4, 5, 6, p 210-219, 6 fig, 2 tab, 9 ref.

Descriptors: *Water pollution sources, *Sewage, *Surface runoff, *E. coli, Correlation analysis, Laboratory tests, Onsite data collections, *Path of pollutants, *Bacteria, Microorganisms.
Identifiers: *Enterococci, Arithmetical relationship, Logarithmic relationship.

Various methods have been used to evaluate the bacteriological conditions of streams. The most satisfactory method, to date, has been the use of an indicator organism. At the present time, the

coliform groups of microorganisms are used as the standard indicator of fecal contamination in this country. However, for many years the enterococci group has been periodically investigated as an indicator of fecal contamination. Of the two groups the enterococci would appear to be the most reliable. In the past several attempts have been made to establish a relationship between the numbers of these two groups in water. The results of two studies are confusing, one determines an arithmetic relationship and the other a logarithmic relationship. A study was undertaken to resolve the apparent difference. The result of this study supports the logarithmic relationship and goes on to present the fact that there is a different correlation between these two groups in accord to the source of contamination, man or warm blooded animals. (Goessling-Texas)
W72-01854

RADIOECOLOGICAL INVESTIGATIONS OF PLUTONIUM IN AN ARCTIC MARINE ENVIRONMENT,

Danish Atomic Energy Commission, Risoe Research Establishment.

A. Aarkrog.

Health Phys. 20 (1): 31-47. Illus. Maps. 1971.

Identifiers: Arctic, Birds, Bivalves, Chain, Crustacea, Echinodermata, Ecological Environment, Fallout, Food, Greenland, Human, Marine, Plutonium, Polychaeta, Radio, Seal, Seaweed, Walrus.

Samples of the human food chain at Thule, Greenland, were collected during the summer of 1968, after the nuclear weapon incident in Jan. As was to be expected from the increased Pu levels in bottom sediments, the highest levels were found in bivalves, crustacea, polychaeta, and echinodermata. The levels in these bottom animals were on the average 2 orders of magnitude as high as the fallout background, in a few cases 4 orders of magnitude. Fish from the bottom water also showed an increased Pu content whereas sea weed, plankton, sea birds, seals, and walruses did not differ significantly from the fall-out background. The Pu concentration in sea water was twice the fall-out background. No samples displayed Pu levels that were considered hazardous to man or higher animals in the Thule district or in any other part of Greenland. Copyright 1971, Biological Abstracts, Inc.
W72-01884

CHARACTERISTICS IN THE DISTRIBUTION OF PROTEUS GROUP BACTERIA IN SEWAGE OF DIFFERENT ORIGIN, (IN RUSSIAN),

Health Research Inst., Moscow (USSR).

G. P. Kalina.

Gig Sanit. 35 (11): 100-101. 1970.

Identifiers: Bacteria, Distribution, Group, Origin, Proteus, Proteus-Mirabilis, Proteus-Vulgaris, Sewage.

The presence of Proteus in waste waters of varied origin can be evaluated both quantitatively and qualitatively using a bile-citrate medium. Industrial effluent from a meat combine had an exceptionally high *P. vulgaris* content (up to 42%), whereas sewage with a predominance of soil and fecal microflora contained a relative abundance of *P. mirabilis*. Copyright 1971, Biological Abstracts, Inc.
W72-01889

CONTAMINATION WITH HELMINTH EGGS OF AGRICULTURAL PRODUCTS FROM SEWAGE-IRRIGATED FIELDS, (IN RUSSIAN),

Institute of Medical Parasitology and Tropical Medicine, Moscow (USSR).

N. A. Romanenko.

Gig Sanit. 35 (11): 95-96. 1970.

Identifiers: Agricultural, Beet-D, Contamination, Eggs, Fields, Grass, Helminth, Irrigated, Onion-M.

Potato-D, Products, Sewage.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

Beet, potato, perennial grass, and onion crops watered with sewage by overhead irrigation, trench irrigation, flooding with clarified or unclarified sewage, and underground irrigation were examined for viable helminth eggs. Only underground irrigation (beets) and flooding with clarified sewage (grasses) yielded uncontaminated crops. Copyright 1971, Biological Abstracts, Inc. W72-01890

CONTRIBUTIONS TO THE STUDY OF BACTERIA IN THE MARINE WATER OFF THE BELGIAN COAST,

Laboratoire Intercommunal de Chimie et de Bacteriologie, Brussel (Belgium).

Jean Kufferath.

Bull Inst Roy Sci Natur Belg. 46 (36): 1-6. 1970.

Identifiers: Bacteria, Belgian, Coast, Coliforms, Enterococcus, Escherichia-Coli, Indicators, Marine, Pollution, Salmonella, Staphylococcus-Aureus.

The state of bacteriological pollution of the coastal waters of Oostende, Knokke and Koksijde was examined. The control was limited to summer, which is considered less polluted. Sampling was made at different times during high tide. Among the organisms tested for were coliform bacteria, Escherichia coli, Enterococcus, Staphylococcus aureus, Salmonella, and sulfate reducers. The present state of pollution (1969) is comparable to that found in 1954, and has not improved. Regular controls should be made periodically in order to determine local fluctuations and the most active causes. Copyright 1971, Biological Abstracts, Inc. W72-01908

UNRESOLVED PROBLEMS OF WATER RADIOECOLOGY, (IN RUSSIAN),

G. G. Polikarpov.

Radiobiologiya. 10 (2): 242-252. Illus. Maps. 1970.

Identifiers: Ecology, Fish, Radio, Ulva-rigida, Unresolved.

Unresolved problems of water radio-ecology are examined in fish and Ulva rigida through an analysis of the current state of investigations in the field. The physical-chemical condition of radionuclides in the radioecological processes of concentration, discovery of the mechanisms governing the entry, accumulation and distribution of radionuclides in living systems and the problem of protecting life from radioactive contamination are examined. Copyright 1971, Biological Abstracts, Inc. W72-01941

DETERMINING THE DEMAND AND ECONOMIC VALUE FOR THE WATER-BASED OUTDOOR RECREATION RESOURCES AT LAKE MACBRIDE STATE PARK IN THE SUMMER OF 1970,

Iowa Univ., Iowa City. Water Resources Research Inst.

For primary bibliographic entry see Field 06D.

W72-01980

CHARACTERISTICS AND POLLUTION PROBLEMS OF IRRIGATION RETURN FLOW.

Utah State Univ., Foundation, Logan.

Available from the National Technical Information Service as PB-204 817, \$3.00 in paper copy, \$0.95 in microfiche. Robert S. Kerr Water Research Center, Ada, Oklahoma, May 1969. 237 p, 12 fig, 40 tab, 945 ref. FWPCA Program 13030--05169, Contract 14-12-408.

Identifiers: *Irrigation practices, *Return flow, *Salinity, *Water pollution sources, *Water quality control, Legal aspects, Consumptive use, Water pollution effects, Desalination, Water reuse, Water rights, Pesticide residue, Irrigation water, Riparian rights.

Identifiers: *Irrigation return flow, Research needs.

An extensive review of the literature was made to assess the present state of scientific knowledge and technology regarding water pollution problems associated with the practice of irrigation and occurring in irrigation return flow. Literature dealing specifically with irrigation return flow was sparse. Eighty percent of the irrigated area of the U.S. was found to fall within an area in which the water demands exceed or will exceed the supply by 1980. Water quality changes during irrigation were found to be influenced by: (1) biochemical action, (2) erosion, (3) evaporation and transpiration, (4) filtration, (5) heat transfer, (6) ion exchange, (7) leaching, (8) precipitation, and (9) sorption and chelation. The effect of irrigation on the subsequent reuse of water by other users was considered. Feasibility studies have been conducted on treating and disposing of return water. A need was found for economic research explicitly concerned with irrigation return flow. The legal aspects of reuse and water quality of irrigation return flows were examined and the recommendation made for more intensive study of the inseparable nature of quality-quantity management in relation to institutional, economic, and legal restrictions. This article contains 245 references and a separate bibliography of 700 entries. (Hornby-EPA) W72-01984

DEVELOPMENT OF PHOSPHATE-FREE HOME LAUNDRY DETERGENTS,

ITT Research Inst., Chicago, Ill. Technology Center.

Karl A. Roseman, and Warner M. Linfield.

Copy available from GPO Sup Doc as EP210:16080 DVF, \$1.00; microfiche from National Technical Information Service as PB-204 867, \$0.95. Environmental Protection Agency Water Quality Office, Water Pollution Control Research Series, December 1970. 103 p, 62 fig, 4 tab, 10 ref, append. EPA Program 16080 DVF Contract 14-12-575.

Identifiers: *Phosphates, *Detergents, *Surfactants, Biodegradation, Eutrophication, Formulation, Chelation, Water pollution control, Testing, Evaluation, Linear alkylate sulfonate, Silicates.

Identifiers: *Phosphate-free detergents, Carboxymethylcellulose, Foam stabilizer, Sodium acetate, Trisodium nitrilotriacetate, Sodium citrate.

A number of surfactants were synthesized for incorporation into phosphate-free detergents. Surfactants were chosen with the supposition that they may possess hard ion chelating properties that would be unaffected by hard water. Their cleaning abilities were compared with formulations containing linear alkylate sulfonate (LAS). The formulae of these test surfactants compensated for the phosphate functions by increasing concentration of common detergent builders and other additives. The finished formulations contained a 2% carboxymethylcellulose concentration. Most frequently used silicate levels were above those currently employed; sodium acetate and sodium carbonate were investigated for reservoirs of alkalinity and surfactant compatibility with sodium chloride and sodium sulfate was also examined. Sodium citrate and trisodium nitrilotriacetate at moderate concentrations levels were investigated in combination with surfactants. Five surfactants were synthesized and 15 detergent formulations screened. A few basic formulations performed well at specific hardness levels under test conditions and results leave little doubt that an acceptable phosphate-free home laundry detergent can be developed. (Auen-Wisconsin) W72-01986

EUTROPHICATION: SMALL FLORIDA LAKES AS MODELS TO STUDY THE PROCESS,

Florida Univ., Gainesville. Dept. of Environmental Engineering.

Patrick L. Brezonik, and Hugh D. Putnam.

Proceedings of the Seventeenth Southern Water Resources and Pollution Control Conference, April 16-18, 1968. p 315-333, 3 fig, 8 tab, 9 ref. Grant No. 16010DON.

Identifiers: *Eutrophication, *Limnology, *Essential nutrients, *Primary productivity, Aquatic algae, Trophic level, Water quality, Florida.

Identifiers: *Anderson-Cue Lake, Melrose (Florida).

Eutrophication is a process of lake aging which can be accelerated by nutrient enrichment. This enrichment manifests itself in a variety of largely deleterious effects on the lacustrine water quality and biota. Response of lakes to increased nutrient loads is highly individualistic and dependent on numerous physical, chemical and biological factors which define the lake's original trophic structure. The assimilative capacity of a lake, i.e. the nutrient load it can accept without deviating from certain imposed water quality standards and conditions, must be known for intelligent water quality management. A small isolated Florida lake has received a controlled amount of nutrient loading. Anderson-Cue an oligotrophic lake of 19.1 acres.

A preliminary investigation indicated a small nutrient supply in the lake, which reflected the impoverished sandy soils, sparse lake biota, and low primary productivity. Sewage effluent enriched with nitrogen and phosphorous compounds has been added to the experimental lake since March 1967. The lake's response to the increased nutrient flux is being determined by monitoring a variety of chemical and biological parameters, including phytoplankton species composition, primary production, chlorophyll, nitrogen and phosphorous forms, dissolved oxygen and trace metals. Bioassay methods have indicated that phosphorous is still the limiting nutrient. In the first year of study, effects on water quality and trophic status have been small. (EPA abstract) (See also W72-01991) W72-01990

APPLICATION OF MATHEMATICAL MODELS TO THE EUTROPHICATION PROCESS,

Florida Univ., Gainesville. Dept. of Environmental Engineering.

Gainesville, Florida, Environmental Engineering Department.

Patrick L. Brezonik.

Proceedings of the Eleventh Conference of Great Lakes Research, 1968, p 16-30. 5 fig, 2 tab, 23 ref. Grant No. 16010DON.

Identifiers: *Eutrophication, *Mathematical model, *Limnology, *Essential nutrients, *Trophic level, Lakes, Nitrogen, Nutrients.

The trophic state of a lacustrine ecosystem is maintained by complex interactions between many habitats, resources and organisms, which are often poorly understood. The interactions of the variables are difficult to identify and quantify by laboratory and field studies alone. However, valuable insight into ecosystem processes can be obtained by formulating simple mathematical models to simulate ecosystem behavior on digital or analog computers. Through techniques of mathematical modeling, overall ecosystem behavior can be studied as functions of habitat and resource initial conditions and their variations, and solutions to complex issues can be obtained. A variety of ecosystem models varying in complexity and sophistication can be formulated for specific purposes. For example, the process of nutrient enrichment of lakes (eutrophication) can be described as a simple function of net nitrogen and phosphorous input rates. The effect of eutrophication on the trophic state can best be described by dynamic models of the lacustrine ecosystem. Distribution of nutrients, carbon or energy in a lake can be described dynamically as a function of nutrient loading and environmental factors. Several types of dynamic models are discussed relevant to the relation between nutrient enrichment and trophic state. A simple single ecosystem model has been formulated for nitrogen cycling in a lake, and its characteristics are described. The applications and limitations of various types of models to simulation of lake processes, including eutrophication, are discussed. (See also W72-01990) (EPA abstract) W72-01991

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Sources of Pollution—Group 5B

WATER QUALITY INVESTIGATIONS, SOURIS RIVER BASIN, NORTH DAKOTA - 1969.

Environmental Protection Agency, Kansas City, Mo.

Superintendent of Documents classification number is EP2.2:So8. Report, February 1971. 62 p. 5 fig. 23 tab, 10 ref.

Descriptors: *Water pollution sources, *Water pollution effects, Sewage effluents, Impaired Water Quality, Oxygen sag, Wildlife refuges, North Dakota.

Identifiers: Souris (Mouse) River (North Dakota), Minot J Clark Salyer Wildfowl Refuge, Hudson Bay Drainage.

Water quality conditions in the United States portion of the Souris River Basin during June - October 1969 were studied. The River basin, study area and objectives are described and a brief background of existing regulations and water quality conditions. Pollution sources are identified and their effect on the river determined. River water quality data are presented and evaluated, and violations of water quality standards are listed. Recommendations are made to reduce or eliminate the waste discharges impairing water quality in the Souris River. (EPA abstract)

W72-01992

MERCURY POLLUTION: MICHIGAN'S ACTION PROGRAM,

Michigan Water Resources Commission, Lansing.

W. G. Turney.

Journal Water Pollution Control Federation, Vol 43, No 7, p 1427-1438, July 1971. 1 fig.

Descriptors: *Water pollution sources, *Heavy metals, *Trace elements, *Data collections, *Michigan, Surface waters, Sediments, Sampling, Streams, Reservoirs, Lakes, Bottom sediments, Industrial wastes, Municipal wastes, Pollutants.

Identifiers: *Mercury.

On February 11, 1970, members of the Michigan Department of Public Health and the Water Resources Commission staff met in Toronto at a regular meeting of the advisory board of International Joint Commission on the control of pollution of international boundary waters. In response to this meeting, the Michigan Water Resources Commission began a state-wide sampling program of industrial waste discharges to check for mercury content. This screening program included the gathering of bottom sediment samples from the mouths of major rivers entering the Great Lakes, and downstream of municipal and industrial waste treatment plant outlets. Trace concentrations of mercury were found in some of the samples. In all cases, the concentration was below 1 mg/kg. The Michigan Department of Public Health cooperated by gathering samples of raw wastewater in more than thirty communities throughout the state where industries discharge waste effluent into the municipal collection and treatment system. Trace levels of mercury were detected in some of the larger communities. Water supply samples taken from all communities using water from the St. Clair River, Lake St. Clair, the Detroit River, and Lake Erie showed negative mercury results. (Woodard-USGS)

W72-01995

NATURAL RELATIONSHIPS OF INDICATOR AND PATHOGENIC BACTERIA IN STREAM WATERS,

Detroit Univ., Mich. Dept. of Biology.

R. J. Smith, and R. M. Twedt.

Journal Water Pollution Control Federation, Vol 43, No 11, p 2200-2209, November 1971. 4 fig, 6 tab, 16 ref. FWQA Grant 16030.

Descriptors: *Water pollution sources, *Rivers, *Bacteria, *Pollutant identifications, *Michigan, Analytical techniques, Sampling, Coliforms, Streams, Pathogenic bacteria, Streptococcus, Salmonella.

Identifiers: *Saline River (Mich), *Huron River (Mich).

An extensive quantitative bacteriological examination was conducted at 10 sampling sites on the Saline River and 24 on the Huron River in southeastern Michigan from June through October 1968. The average total coliform, fecal coliform, fecal streptococcus, and *Salmonella* concentrations during the sampling season produced stream profiles which were analyzed for natural relationships between indicator and *Salmonella*. *Salmonellae* were isolated at four sites on the Saline and two on the Huron. *Salmonellae* were never isolated when the fecal coliform concentration fell below 100 organisms/100 ml in the Saline and 200/100 ml in the Huron. Geometric mean ratios relating pathogens to indicators for samples containing *Salmonellae* were one *salmonella* to 39,960 coliforms, 2,737 fecal coliforms, and 8,702 fecal streptococci in the Saline and 11,580 coliforms, 300 fecal coliforms, and 191 fecal streptococci in the Huron. (Woodard-USGS)

W72-01996

A CRITICAL EXAMINATION OF BATHING WATER QUALITY STANDARDS,

Tufts Univ., Medford, Mass. Dept. of Civil Engineering.

D. H. Foster, N. B. Hanes, and S. M. Lord, Jr. Journal Water Pollution Control Federation, Vol 43, No 11, p 2229-2241, November 1971. 2 fig, 3 tab, 30 ref.

Descriptors: *Coliforms, *Bacteria, *Water quality, *Standards, *Swimming, Recreations, Sampling, Data collections, Water pollution sources, Water pollution effects, Public health, Human pathology.

Identifiers: *Bathing water standards.

Pseudomonas aeruginosa and *enterococci* were examined as potential water quality indicators to be used with members of the coliform group. *Enterococci* are present in buccal and nasal as well as intestinal discharges. An extensive study of these organisms and total coliforms was conducted at three freshwater bathing areas. It was found that as many cases of ear infection resulted from swimming in filtered, chlorinated pool water as from bathing beaches where coliform standards were exceeded. Coliform levels exceeding present standards should be considered only as guides. Further investigation of bathing-related health problems should be required before a beach is approved for swimming purposes. (Woodard-USGS)

W72-01997

SUBSURFACE DISTRIBUTION OF NITRATES BELOW COMMERCIAL CATTLE FEEDLOTS, TEXAS HIGH PLAINS,

Texas Tech Univ., Lubbock. Dept. of Geosciences.

W. D. Miller.

Water Resources Bulletin, Vol 7, No 5, p 941-950, October 1971. 5 fig, 2 tab, 3 ref.

Descriptors: *Farm wastes, *Confinement pens, *Water pollution sources, *Path of pollutants, *Texas, Malenclaves, Groundwater, Groundwater movement, Nitrates, Runoff, Infiltration, Sampling, Monitoring.

Identifiers: *Groundwater pollution, High Plains (Tex).

Samples for water-quality analyses were collected from beneath eighty commercial cattle feedlots in the Texas High Plains. Twenty-two feedlots were drilled and/or cored to establish vertical gradients of dissolved solids. Sample and gamma logs, size analyses and vertical permeability of cores were determined from samples beneath these lots. The study includes lots ranging in age from 35 years to new installations. Runoff collection-systems on lots include playas, man-made ponds, and dammed and undammed stream channels. Infiltration of feedlot liquid waste to the watertable below feedyards is in-

significant in most localities. Infiltration of feedlot runoff and subsequent concentration of dissolved ions in groundwater in the High Plains are dependent upon, among other things, (1) surface and subsurface geology, (2) depth to water, (3) thickness of the groundwater zone, and to (4) differences in lateral and vertical permeabilities of the Ogallala Formation, the major aquifer. No regional subsurface pollution problem exists today nor is one foreseen from cattle feedlot runoff in the Texas High Plains. (Knapp-USGS)

W72-02003

DISTRIBUTION OF SUSPENDED OIL PARTICLES FOLLOWING THE GROUNDING OF THE TANKER ARROW,

Bedford Inst., Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.

W. D. Forrester.

Journal of Marine Research, Vol 29, No 2, p 151-170, May 15, 1971. 5 fig, 3 tab, 2 ref.

Descriptors: *Oily water, *Suspended load, *Particle size, *Path of pollutants, *Currents (Water), Ocean currents, Atlantic Ocean, Mathematical models.

Identifiers: *Oil spills.

In Chedabucto Bay, Nova Scotia, following the grounding of the tanker Arrow on February 4, 1970, small (5 microns to 1 or 2 mm) oil particles were found in the water column. The origin of the particles, their distribution in size and in depth, and the transport of particles out of Chedabucto Bay into the open ocean are discussed. A simple steady-state model relates turbulent-energy distribution to oil-particle distribution over corresponding ranges of wavelength and particle size. The particles were detected as far as 250 km from their source and provided evidence of a current flowing southwestward along the Nova Scotia Coast at a speed of about 8 km-day. (Knapp-USGS)

W72-02036

PESTICIDE CONTAMINATION OF A SHALLOW BORED WELL IN THE SOUTHEASTERN COASTAL PLAINS,

South Piedmont Conservation Research Center, Watkinsville, Ga.

M. J. Lewallen.

Proceedings of the National Ground Water Quality Symposium, Denver, Colorado, August 25-27, 1971: Ground Water, Vol 9, No 6, p 45-48, November-December 1971. 4 fig, 4 tab, 8 ref.

Descriptors: *Water pollution sources, *Pesticides, *Water wells, *Path of pollutants, Pesticide residues, Soil contamination, Leaching Translocation, Atlantic Coastal Plain.

A shallow farm well was contaminated with persistent pesticides when contaminated soil was used as backfill material around the well casing. The well location was less than 25 feet from a site previously used for flushing an insecticide sprayer. Pesticide level in the water was monitored for more than 4 years, during which a gradual decline in concentration has occurred. Soil core samples taken in the area surrounding the well indicate relatively high surface contamination but very little downward movement. Sediment samples from the bottom of the well exhibited highest concentration of all samples. (Knapp-USGS)

W72-02078

GASOLINE POLLUTION OF A GROUND-WATER RESERVOIR - A CASE HISTORY,

Los Angeles Dept. of Water and Power, Calif.

D. E. Williams, and D. G. Wilder.

Proceedings of the National Ground Water Quality Symposium, Denver, Colorado, August 25-27, 1971: Ground Water, Vol 9, No 6, p 50-54, November-December 1971. 8 fig, 4 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Gasoline, *Water pollution treatment,

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

*Water wells, Groundwater movement, Withdrawal, Oil industry, California. Identifiers: *Groundwater contamination.

A leak in a product gasoline pipeline near the City of Los Angeles caused contamination of a valuable groundwater supply. Since 1968, 250,000 gallons of gasoline have seeped into the underground reservoir. Remedial measures include extensive analytical studies of the two-fluid flow system as well as an effort in the field to try and clean up the gasoline and restore the aquifer to service. The field methods involve a system of skimming wells designed to produce a high gasoline-water ratio. To date, 50,000 gallons of gasoline have been removed from the aquifer. (Knapp-USGS) W72-02079

PETROLEUM CONTAMINATION OF GROUND WATER IN MARYLAND,
Maryland State Dept. of Water Resources, Annapolis. Groundwater Management Div.

J. R. Matis.

Proceedings of the National Ground Water Quality Symposium Denver, Colorado, August 25-27, 1971: Ground Water, Vol 9, No 6, p 57-61, November-December 1971. 1 fig, 4 ref.

Descriptors: *Oily water, *Groundwater, *Maryland, *Water pollution sources, *Water pollution control, Hydrogeology, Aquifer characteristics, Aquifers, Water law, Legal aspects, Biodegradation. Identifiers: Oil spills.

In Maryland, most counties record cases of petroleum contamination of groundwater. Areas west of the Fall Zone have the highest frequency of occurrence, in contrast to the Coastal Plain geologic province to the east. In both areas, the problems are very localized. Many petroleum fuels do not deteriorate in the groundwater system. Identification of specific petroleum products in groundwater is generally not possible with present techniques. Once a source of contamination is located, it must be stopped or removed. Because it is virtually impossible to remove the contaminant from the groundwater, legal and regulatory problems continue for months or years after an original complaint. (Knapp-USGS) W72-02080

GROUND-WATER POLLUTION POTENTIAL OF A LANDFILL ABOVE THE WATER TABLE,
Pennsylvania State Univ., University Park. Dept. of Geosciences.

M. A. Apgar, and D. Langmuir.

Proceedings of the National Ground Water Quality Symposium, Denver, Colorado, August 25-27, 1971: Ground Water, Vol 9, No 6, p 76-94, November-December 1971, 24 fig, 4 tab, 39 ref.

Descriptors: *Landfills, *Water pollution sources, *Karst, *Pennsylvania, Garbage dumps, Waste disposal, Oxygen demand, Solutes, Path of pollutants, Biodegradation, Leaching, Percolation, Groundwater movement. Identifiers: *State College (Pa).

A study of the character and movement of landfill leachate through unsaturated soil was begun in 1967 at the State College (Pennsylvania) Regional Sanitary Landfill, which has operated since 1962. The landfill occupies a gently sloping valley with a water table more than 200 feet below land surface. Precipitation averages about 37 inches as rain per year. Residual sandy-clay to sandy-loam soils range from a few feet to greater than 70 feet in thickness on a sandy dolomite bedrock. The quality and quantity of leachate beneath the landfill varies considerably with the topographic setting of landfill trenches or cells. Leachates 2 feet under an up-slope cell which received only direct precipitation, had the following maximum values 3-12 months after refuse burial: specific conductance 8445 micromhos, Cl 1890 mg/liter, BOD 3300 mg/liter, NH3 -N 540 mg/liter, and total Fe 225 mg/liter.

Water infiltrated a downslope cell, saturating the refuse. Even after moving downward in the soil to a depth of 36 feet in 7 years, the leachate beneath this cell had a conductance of 6600 micromhos, 600 mg/liter Cl, over 9000 mg/liter BOD, 40 mg/liter NH3-N, and 100 mg/liter total Fe. Leachate beneath instrumented cells is moving downward in the subsoil at the rate of 6-11 ft/yr. Highly contaminated leachate moves to depths of 50 feet or more in soils beneath downslope cells. Improper design of landfills emplaced above the water table can result in serious groundwater pollution. (Knapp-USGS) W72-02081

PLUTONIUM-239 IN AND OVER THE ATLANTIC OCEAN,
Woods Hole Oceanographic Institution, Mass.
V. T. Bowen, K. M. Wong, and V. E. Noshkin.
Journal of Marine Research, Vol 29, No 1, p 1-10, January 15, 1971. 1 fig, 1 tab, 20 ref. USAEC Contract AT (30-1)-2174.

Descriptors: *Fallout, *Aerosols, *Sea water, *Radioactive wastes, *Path of pollutants, Nuclear explosions, Nuclear powerplants, Radioisotopes, Chemical precipitation. Identifiers: *Plutonium.

Plutonium-239 is found in over-ocean fallout aerosols in about the same ratio to Stontium-90 as that reported over land. In seawater, Pu-239:Sr-90 ratios are shown to be less than half of those in over-ocean aerosols, confirming geochemical separation of these nuclides in the ocean. It is suggested that the sedimentation of Pu-239 may be more involved with biological processes than Ce-144 or Pm-147. (Knapp-USGS) W72-02083

CESIUM-137 IN THE NORTH ATLANTIC MEASURED BY SELECTIVE ABSORPTION IN SITU,
Rhode Island Univ., Kingston. Narragansett Marine Lab.

S. L. Kupferman.

Journal of Marine Research, Vol 29, No 1, p 11-18, January 15, 1971. 1 fig, 1 tab, 16 ref. ONR Contract N00014-68-A-0215-0003.

Descriptors: *Tracers, *Mixing, *Sea water, *Thermocline, *Fallout, *Radioisotopes, Radioactivity techniques, Radioactive wastes, Path of pollutants, Ocean currents, Ocean circulation, Currents (Water), Cesium.

By means of selective absorption in situ, Cesium-137 was measured in November and December 1968 in two depth profiles (near 39 deg N, 69 deg W) and in ten widely scattered surface samples in the North Atlantic Ocean. The Cs-137 concentrations in the depth profiles, which reflect differences in the T-S structure of the water, fall off toward the main thermocline. If it is assumed that the total amount of Cs-137 in the profiles is characteristic of the Cs-137 activity per unit surface area in the layers above the main thermocline, then calculation of the residence time of Cs-137 (and presumably of water) above the main thermocline leads to times of 2.5 to 7 years. (Knapp-USGS) W72-02084

THE ANACOSTIA RIVER, ECOLOGICAL IMBALANCE OF AN URBAN STREAM VALLEY,
National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center.
For primary bibliographic entry see Field 05C. W72-02093

NITROGEN SUPERSATURATION IN THE COLUMBIA AND SNAKE RIVERS,
Environmental Protection Agency, Seattle, Wash. Region X.

R. L. Rulifson, and G. A. Abel.

Available from the National Technical Information Service as PB-205 150, \$3.00 in paper copy, \$0.95

in microfiche. Working Paper No 82, July 1971. 116 p, 22 fig, 6 tab, 48 ref. TS 09-70-208-016.2.

Descriptors: *Nitrogen, *Dams, *Spillways, *Hydroelectric power, *Anadromous fish, *Salmonids, *Toxicity, Water resources development, Water quality, Standards, Salmon, Rainbow trout, Gases, Supersaturation. Identifiers: *Columbia River, *Snake River, Power peaking, Embolism, Dissolved gases.

Nitrogen supersaturation, caused by the series of hydroelectric dams on the Columbia and Snake Rivers, seriously threatens the future of salmon and steelhead in the Pacific Northwest. A study was made to determine the scope of the problem and recommend solutions. Nitrogen supersaturation is caused when river flows exceed the capacity of power generating turbines in dams and excess flow must be passed over the spillway. The plunge of water into the stilling basin forces excessive air (79 percent nitrogen) into solution. Concentrations of dissolved nitrogen up to 147 percent of surface equilibrium concentrations have been measured. Levels above 105 percent produce symptoms of gas-bubble disease in fish and levels above 120 percent are lethal. Planned installation of slotted gates and bypass of water through empty turbine bays in some dams will reduce spilling but hazardous nitrogen levels will still occur in years of average and higher spring runoff. Increasing use of the hydroelectric system for peak power generation may add to the problem. Recommendations include establishment of a water quality standard of a maximum of 110 percent nitrogen supersaturation, establishment of a regional council to implement a control plan, expanded trapping and hauling of fish around river reaches with high nitrogen levels, revisions to water management operations to reduce spills during periods of fish migration, and provisions at dams of additional facilities to bypass excess flows without increasing nitrogen levels. (See also summary report W72-02160) (EPA-Abstract) W72-02159

SUMMARY REPORT, NITROGEN SUPERSATURATION IN THE COLUMBIA AND SNAKE RIVERS,
Environmental Protection Agency, Seattle, Wash. Region X.

R. L. Rulifson, and G. A. Abel.

Summary Report, July 1971. 11 p, 1 fig. TS 09-70-208-016.1.

Descriptors: *Nitrogen, *Dams, *Spillways, *Hydroelectric power, *Anadromous fish, *Salmonids, *Toxicity, Water resources development, Water quality, Standards, Salmon, Rainbow trout, Gases, Supersaturation.

Identifiers: *Columbia River, *Snake River, Power peaking, Embolism, Dissolved gases.

Summary of TS 09-70-208-016.2, Working Paper No. 82. (See also W72-02159) W72-02160

PROBLEMS OF INDUSTRIAL RESIDUAL WATERS IN THE HOOGHLY ESTUARY ZONE (INDIA), CONCRETELY THE ONES FROM PAPER PULP AND HYDROGENATED VEGETABLE OIL INDUSTRIES (PROBLEMES D'EAUX RESIDUAIRES INDUSTRIELLES DANS LA ZONE DU HOOGHLY ESTUARY (INDE), NOTAMMENT DES FABRIQUES DE PATE A PAPIER ET D'HUILE VEGETALE HYDROGENEE),
Institut Central de Recherches sur les Peches Interieures, Barrackpore (India). A. K. Basu.

La Tribune de Cebedeau, Vol 22, No 309-310, p 452-456, August-September 1969. 6 tab, 3 fig, 6 ref.

Descriptors: *Water pollution sources, *Pulp and paper industries, *Pulp wastes, *Anaerobic digestion, *Sedimentation, *Settling Basins, *Chemical precipitation, *Coagulation, Plastics.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Effects of Pollution—Group 5C

Identifiers: *Hooghly Estuary, Hydrogenated vegetable oil.

The industrial concentration is very dense between Tribeni and Birlapur on both sides of the Hooghly Estuary. Jute, fabric, tanning, shellac, chemical products, paints and chlorine industries are arranged along 85 kilometers on both banks. Waste waters are directly or indirectly disposed into the estuary, most of the time without having any kind of pre-treatment; this created a serious problem to the Regional Services of Public Health. The article deals with the pollution which occurs due to the activities of paper pulp and hydrogenated vegetable oil (Margarine) industries. The treatment described is based on chemical precipitation, anaerobic digestion and sedimentation processes. (Minguez-Arizona)
W72-02208

CHEMICALS IN THE ENVIRONMENT, R. L. Rudd.

Calif Med. 113 (5): 1970. 27-32.

Identifiers: Air, Bird, Chemicals, Chlorine, Concentration, Environment, Human, Lead, Mercurial, Organo, Tissue.
W72-02251

5C. Effects of Pollution

CONTROL OF BENTHIC DEPOSITS IN LAKES, Massachusetts Univ., Amherst. Dept. of Civil Engineering.

For primary bibliographic entry see Field 02H.

W72-01699

A PRACTICAL EVALUATION OF THE CLARKE-BUMBUS PLANKTON SAMPLER AND SUGGESTIONS FOR ITS USE, Minnesota Univ. Water Resources Research Center.

J. B. Conway, F. R. Schiebe, T. A. Olson, and T. O. Orlaugh.

Free copies available at Water Resources Research Center, Univ. of Minn., Room 107 Hubbard Building, 2675 University Ave., St. Paul, Minn. 55114. Univ. of Minn., School of Public Health, Limresta, Research Report No. 1. 1971. 28 p. 5 fig., 4 tab., 17 ref. OWRR Project No.: A-022-Minn (2).

Identifiers: *Sampling, *Plankton, Lake Superior, Minnesota, Lakes, Phytoplankton, Zooplankton, Nets, Aquatic microorganisms, *Filtration. Identifiers: *Clarke-Bumpus plankton sampler, *Suspended particle index, Calibrations.

The validity of single samples and the uniformity of a series of samples obtained with the Clarke-Bumpus plankton sampler as well as the reliability and uniformity of this device from the standpoint of its mechanical operation has been questioned by a number of modern investigators. Since most of the critics had found fault with field operation, which related to the mechanical functioning of the sampler, this aspect was examined first. It was discovered that the sampler functioned perfectly well if one was willing to give it a minimum amount of attention including certain adjustments. The most important of these was the trigger spring tension. With methods and materials used, the attempt to calibrate instruments in the field were unsuccessful. A formula was developed which expresses the filtering efficiency of the Clarke-Bumpus sampler with various types of nets attached. (Walton-Minnesota)
W72-01735

PHYTOPLANKTONIC NITROGEN AS AN INDEX OF CULTURAL EUTROPHICATION, Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.

R. G. Wetzel, and Bruce A. Manny. Available from the National Technical Information Service as PB-204 707, \$3.00 in paper copy, \$0.95

in microfiche. Completion Report, (November, 1971). 15 p, 1 fig, 36 ref. OWRR-B-009-MICH (1)

Identifiers: *Nitrogen, Plankton, *Eutrophication, Pollutant identification, Algae, Analytical techniques, *Ultraviolet radiation, Dissolved oxygen, Lakes, Phytoplankton, Nutrients.

Identifiers: *Pollution index.

Algae less than 10 microns in diameter are nitrogen rich on a cell volume basis compared to algae larger than 10 microns in diameter. A procedure for dissolved organic nitrogen (DON) determination in natural waters was developed. The procedure utilized high intensity ultraviolet light to destroy the DON and is 100-fold more sensitive than the micro-Kjeldahl procedure. The procedure can differentiate UV-labile and UV-refractory DON within the DON pool present in a wide variety of natural water bodies. Allochthonous dissolved organic carbon (DOC) and nitrogen (DON) comprise about half the DOC and DON leaving the lake outlet implying about half the DOC and DON leaving the lake originates within the lake as a result of plant photosynthesis and decomposition processes. During transport in a hardwater stream, UV-labile DON was removed from the water and UV-refractory DON accumulated in the water until a stable equilibrium ratio of about 7:3 refractory to labile DON was attained. Secretion of DOC and DON by two aquatic macrophytes in axenic culture was directly proportional to increasing carbon fixation rates, light intensity, pH, cationic concentration and organic carbon concentration. Organic enrichment may accelerate nutrient cycles and eutrophication rates in hardwater lakes by stimulating increased secretion of DOC and DON by the littoral flora.

W72-01780

BIOLOGICAL ASSAYS AND WATER QUALITY IN MINNESOTA, Minnesota Univ., Minneapolis. Limnological Research Center.

Dragica Matulova. Interim Report No 6, March 1970. 112 p, 31 fig, 14 tab, 103 ref, 4 append. NSF supported.

Identifiers: *Bioassay, *Water quality, *Minnesota, *Measurement, Water pollution, Bacteria, Scenedesmus, Chlamydomonas, Analysis, Laboratory tests, Chemical analysis, Optical properties, Cultures, Mathematical studies, Physical properties, Physiological ecology, Limnology, Sampling, Lakes, Water pollution effects, Test procedures.

Identifiers: Saprobity Zones Determination, Microcystis, Escherichia coli, Lake Minnetonka (Minn), Biomass Titre test (BMT).
W72-01784

Physiological methods can help not only to determine the present pollution level, but also to predict effects of substances introduced into natural waters by sewage and wastes. Bioassays with Scenedesmus, Chlamydomonas, and Microcystis cultures and one ecological procedure (Saprobity Zones Determination) were applied in a study of water pollution of different Minnesota lakes and rivers. The Biomass Titre-BMT procedure was modified by adding the control for the BMT of bacteria. Values for the Biological Index of water quality were computed from the results of BMT and showed good agreement with saprobity zones determined. Chemical data substantiated conclusions from physiological procedures. Enrichment experiments with Minnesota lake and river waters show that nitrogen and phosphorus play an important role in algal growth. Concentrations up to 0.7 mg/l nitrate-nitrogen is limiting and 7.0 is optimal for Scenedesmus quadridicula growth. The growth rate of the culture increased linearly in concentrations from 1.4 to 7.0 mg/l nitrate-nitrogen. Absence of phosphate-phosphorus limited culture growth; growth was proportional to the concentrations of phosphate-phosphorus up to 0.5 mg/l. Most waters investigated at 20 localities in Minnesota could be described as beta-mesosaprobic. (Jones-Wisconsin)
W72-01783

THE DIVERSITY OF PIGMENTS IN LAKE SEDIMENTS AND ITS ECOLOGICAL SIGNIFICANCE,

Minnesota Univ., Minneapolis. Dept. of Botany. Jon E. Sanger, and Eville Gorham. Limnology and Oceanography, Vol 15, No 1, p 59-69, 1971. 2 fig, 3 tab, 21 ref. NSF G-23309.

Identifiers: *Pigments, *Lakes, *Sediments, *Indicators, Chromatography, Chlorophyll, Trophic level, Eutrophication, Algae, Decomposing organic matter, Minnesota, Cyanophyta, Trees, Grasses, Leaves, Forest soils, Sampling, Mud, Phytoplankton, Fluorescence, Photosynthetic bacteria.

Identifiers: Carotenoids, Xanthophylls, Minnesota lakes, Lutein.

Diversity of sedimentary pigments is particularly a consequence of decomposition and source material has a pronounced influence. Concentrations of chlorophyll derivatives in the organic matter of surface sediments in the English Lake District proved sensitive indices of lake fertility. This study investigates further sources of organic matter in lake sediments, by examining plant pigment diversity of widely differing trophic, morphological, and chemical characteristics, and in terrestrial and aquatic plant material in varying stages of decomposition. Lakes chosen (18 in Minnesota and 6 in English Lake District) included those whose primary productivity and water and sediment chemistry are now being studied. Thin-layer chromatography shows a large number of pigments (chlorophyll derivatives and carotenoids) in profundal lake sediments, diversity being somewhat greater in eutrophic than in oligotrophic lakes. While quantity of pigments per gram organic matter is much lower in oligotrophic than eutrophic lakes, pigment diversity is only slightly lower. Sedimentary pigments are much more numerous (24-27) than those of upland vegetation (7-8), aquatic macrophytes (12-15), and planktonic algae (10-21). Algal decomposition, which is accompanied by a marked increase in pigment number, seems the most likely cause for the extreme diversity of sedimentary pigments. (Jones-Wisconsin)
W72-01784

OXYGEN SAG AND STREAM SELF-PURIFICATION,

R. E. DeLoach, and E. C. Tsivoglou. Journal Water Pollution Control Federation, Vol 43, No 6, p 1236-1243, 1971. 64 ref.

Identifiers: *Reviews, *Self-purification, *Streams, *Mathematical models, Oxygenation, Photosynthesis, Organic matter, Biochemical oxygen demand, Temperature, Oxygen sag, Benthos, Kinetics, Nitrification, Equations, Computer models.

Literature pertinent to models of stream self-purification is reviewed, including reaeration and oxygen transfer, water temperature, photosynthesis, benthic deposits and demands, biochemical oxygen demands, BOD kinetics, and effects of river canalization. (Wilde-Wisconsin)
W72-01785

BIOLOGY OF WATER POLLUTION: A COLLECTION OF SELECTED PAPERS ON STREAM POLLUTION, WASTE WATER, AND WATER TREATMENT.

Federal Water Pollution Control Administration, Washington, D.C.

Federal Water Pollution Control Administration Publication CWA-3, 1967. 290 p, 107 fig, 58 tab, 2 photo, 530 ref.

Identifiers: *Water pollution, Waste disposal, *Sewage treatment, *Waste water treatment, *Waste water disposal, *Industrial wastes, *Water pollution control, Fish conservation, Pollution abatement, Bibliographies, Ecology, Biology, Fish, Plankton, Water quality, Algae, Aquatic life, Stream pollution, Bacteria, Impurities, Waste treatment.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

This book of selected publications on biology of water pollution, water treatment and sewage and industrial waste treatment contains some of the many excellent and basic pertinent biological papers that have been commonly inaccessible to the contemporary investigator. These papers often quoted and are a portion of the foundation upon which modern aquatic ecological scientific thought and decisions are often based in summarizing water pollution control investigations. This compiled collection will be of assistance in 3 phases of water pollution abatement: (1) it will provide a technical service to the aquatic ecologist through assemblage of informative literature; (2) it will illustrate many of the concepts upon which regulations have been formulated for the protection of aquatic life; and (3) it will aid in the training of new environmental scientists to meet today's and tomorrow's personnel needs in the conservation of our nation's natural resources. (See also W72-01787 thru W72-01820) W72-01786

THE LAKE AS A MICROCOOSM, Illinois State Natural History Survey, Peoria.

Stephen A. Forbes.
In: Biology of water pollution, p 3-9. 1 ref. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Lakes, *Balance of nature, *Biology, *Limnology, Environmental effects, Aquatic life, Food chains, Aquatic environment, Illinois, Wisconsin, Marshes, Biological communities. Identifiers: Fluvial lakes, Watershed lakes, Entomostraca.

A lake is a chapter out of the history of primeval times; it is an organic system of interactions that remained essentially unchanged since a remote geologic period. The outstanding feature of the lake microcosm is that any of its members influences the equilibrium of the whole assemblage. The idea of the unity and sensibility of aquatic ecosystems is illustrated by descriptions of fluvial and water-shed lakes of Illinois with their biotic contents. (See also W72-01786) (Wilde-Wisconsin) W72-01787

SEWAGE, ALGAE AND FISH, Public Health Service, Cincinnati, Ohio.

Floyd J. Brinley.
In: Biology of water pollution, p 10-13. 1 fig, 6 ref. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Sewage, *Streams, *Water pollution effects, *Fish, Algae, Trophic level, Productivity, Food chains, Toxicity, Water pollution control, Decomposing organic matter, Carbon dioxide. Identifiers: *Ohio River Basin.

Discharge of raw sewage into streams imparts toxicity to the area surrounding the outlet. At a distance downstream, however, sewage undergoes bacteriological decomposition, loses its toxicity, and acts as a fertilizer, stimulating the growth of plankton and consequent increase of the fish population. Secondary sewage treatment eliminates toxic ingredients and the entire stream is benefited by the inflow of available nutrients. (See also W72-01786) (Wilde-Wisconsin) W72-01788

BIOLOGICAL ASPECTS OF STREAM POLLUTION, Wisconsin State Committee on Water Pollution, Madison.

A. F. Bartsch.
In: Biology of water pollution, p 13-20. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Water pollution effects, *Self-purification, *Streams, *Aquatic microbiology, Sewage, Biodegradation, Anaerobic bacteria, Plankton, Benthos, Biota, Protozoa, Rotifers, Aquatic life, Food chains, Tubificids, Molds, Bioindicators. Identifiers: Sow bugs, Sludge-worms, Blood-worms.

The distribution of aquatic organisms is influenced by the nature and concentration of pollutants, and may serve as an indicator of water quality, supplementing other analytical data. Heterotrophic organisms use many pollutants or their ingredients as a source of energy and liberate available nutrients; photosynthesizing organisms reduce BOD by enriching water in oxygen. Nevertheless, the efficiency of aquatic flora and fauna in recovery of stream quality is much lower than that of treatment plants. (See also W72-01786) (Wilde-Wisconsin) W72-01789

SOME IMPORTANT BIOLOGICAL EFFECTS OF POLLUTION OFTEN DISREGARDED IN STREAM SURVEYS, Public Health Service, Cincinnati, Ohio. Environmental Health Center.

Clarence M. Tarzwell, and Arden R. Gauvin.
In: Biology of water pollution, p 21-31. 5 fig, 93 ref. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Streams, *Water pollution effects, *Environmental effects, *Aquatic life, *Fish populations, Temperature, Plankton, Self-purification, Salmonids, Water pollution sources, Waste assimilation capacity, Silting, Erosion, Bacteria, Biochemical oxygen demand, Surveys, Streambeds, Oxygen sag, Turbidity, Biology, Eutrophication, Water analysis. Identifiers: Pere Marquette River (Mich), Black River (Mich), Lytle Creek (Ohio), Norris Reservoir (Tenn).

Because the same domestic or industrial pollutant may bring about unsimilar conditions in different streams, it is essential to record in stream surveys the watershed characteristics; these include soil types, vegetative cover, land uses, precipitation, and features pertinent to erosion. These factors determine in a large degree the modifying effect of pollutants on stream temperature, turbidity, nutrient supply, dissolved oxygen, and, in turn, the entire aquatic biota. Attention is called to the importance of bioassays and the critical, rather than average values of temperature, dissolved oxygen, and other factors. (See also W72-01786) (Wilde-Wisconsin) W72-01790

BIOLOGICAL INDICES OF WATER POLLUTION WITH SPECIAL REFERENCE TO FISH POPULATION, Public Health Service, Cincinnati, Ohio; and Oregon State Coll., Corvallis. Dept. of Fish and Game Management.

Peter Doudoroff, and Charles E. Warren.
In: Biology of water pollution, p 32-40. 38 ref. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Bioindicators, *Fish, *Water pollution, Bioassays, Eutrophication, Water pollution control, Water quality, Social aspects, Wastes, Organic matter, Fisheries. Identifiers: Pollution criteria, Pollution indices, Toulumne River (Calif).

A change in the biotic content of a stream, referred to as an index of pollution, is only an index of environmental anomaly and may or may not be of pollutional origin. A negligible level of pollution may have a great effect on aquatic biota, and vice-versa. Deterioration of valuable organisms can best be determined by concentrating attention on these organisms. The use of biological indices should state specifically the factors of their origin, such as

concentration of dissolved oxygen, organic matter, and toxic substances. (See also W72-01786) (Wilde-Wisconsin) W72-01791

ECOLOGY OF PLANT SAPROBIA, R. Kolkwitz, and M. Marrson.

In: Biology of water pollution, p 47-52. 5 ref. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Self-purification, *Aquatic plants, *Decomposing organic matter, Water pollution, Aquatic life, Bioindicators, Trophic level, Systematics.

Identifiers: *Saprobia, Polysaprobia, Mesosaprobia, Oligosaprobia.

A list of about 300 plant organisms that have importance in self-purification of polluted waters is given. The dependence of these organisms on decomposing organic matter, or their degree of saprophytism, is expressed by the term 'saprobia.' In accordance with their requirements, the plants are classified as oligo-, meso-, and poly-saprobic. (See also W72-01786) (Wilde-Wisconsin) W72-01793

EFFECT OF SUNLIGHT AND GREEN ORGANISMS ON RE-AERATION OF STREAMS, New Jersey Agricultural Experiment Station, New Brunswick.

Willem Rudolfs, and H. Heukeleian.
In: Biology of water pollution, p 52-56. 5 fig, 6 ref. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Reaeration, *Light, *Chlorophyta, Dissolved oxygen, Diurnal, Streams, Cyanophyta, Hydrogen ion concentration, Photosynthesis, Water pollution effects, Temperature, Biochemical oxygen demand, Delaware River. Identifiers: Connecticut River, Raritan River.

Analyses of polluted water in the afternoon—during the high level algal photosynthesis—may yield misleading information on dissolved oxygen concentration. This is particularly true of slowly flowing streams analyzed during hot days of the algal growing season. Because the pH values fluctuate in direct relation with dissolved oxygen, unsystematic determination may suggest an erroneous conclusion that the water has a strongly alkaline reaction, or that it receives alkaline pollutants. (See also W72-01786) (Wilde-Wisconsin) W72-01794

THE PLANKTON OF THE SANGAMON RIVER IN THE SUMMER OF 1929, Samuel Eddy.

In: Biology of water pollution, p 57-69. 4 tab, 5 ref. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Plankton, *Rivers, Water pollution effects, Sewage, Reservoirs, Illinois. Identifiers: Sangamon River (Ill).

The effect of treated sewage and impounded water on suspended microscopic plankton was studied in the Sangamon River, Illinois. The results of 1929 collections of Protozoa, Rotatoria, Cladocera, Copepoda, and algae, expressed in numbers per cubic meter, are given in tabular form. The research suggested a considerable increase of the plankton population in the lower part of the river which is attributed to the creation of the reservoir at Decatur and removal of the pollution barrier. (See also W72-01786) (Wilde-Wisconsin) W72-01795

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Effects of Pollution—Group 5C

AQUATIC LIFE IN WATERS POLLUTED BY ACID MINE WASTE,

Public Health Service, Cincinnati, Ohio. Stream Pollution Investigations.

James B. Lackey.

In: Biology of water pollution, p 70-74. 6 fig, 1 tab, 4 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Water pollution sources, *Water pollution effects, *Aquatic life, *Acid mine water, Mine wastes, Systematics, West Virginia, Indiana, Illinois, Sampling, Niches, Protozoa, Acidic water. Identifiers: Thallophyta, Trochelminthes, Arthropoda.

Strongly acid streams and strip pit lakes polluted by sulfuric acid of mining waste yielded 86 species of microscopic Thallophyta, Protozoa, Trochelminthes, and Arthropoda. In waters with reaction below pH 4 the biota consisted of a small number of species; at pH 2.6 several samples showed no life on examination. The most common species of acidic streams and lakes included Euglena mutabilis, Naviculoid diatoms, Chlamydomonas, Distyla, Actinophrys, Ochromonas, and Ulothrix zonata. (See also W72-01786) (Wilde-Wisconsin) W72-01796

A HEAVY MORTALITY OF FISHES RESULTING FROM THE DECOMPOSITION OF ALGAE IN THE YAHARA RIVER, WISCONSIN,

Wisconsin Dept. of Conservation, Madison; and Wisconsin Board of Health, Madison.

Kenneth M. Mackenthun, and Alfred F. Bartsch.

In: Biology of water pollution, p 75-78. 3 fig, 1 tab, 2 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Control Administration, Washington, D C, 1967.

Descriptors: *Fishkill, *Cyanophyta, *Decomposing organic matter, Toxicity, Dissolved oxygen, Algae, Wisconsin.

Identifiers: *Yahara River (Wis), Aphanizomenon flos aquae, Oxygen depletion.

Early in October, 1946, a heavy mortality of all fish species occurred in the Yahara River, Wisconsin. Before expiring, the fish, including carp, northern pike, walleye pike, crappies, suckers, and eel, congregated near the shore breathing at the surface. The mortality was correlated with the critically low concentration of dissolved oxygen—under 1.0 ppm; this deficiency resulted from the decomposition of an algal mass, largely Aphanizomenon flos aquae. As revealed by laboratory trials, toxic substances released by decomposing algal tissues were a contributing factor. (See also W72-01786) (Wilde-Wisconsin) W72-01797

SUGGESTED CLASSIFICATION OF ALGAE AND PROTOZOA IN SANITARY SCIENCE,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Interference Organisms Studies and Water Supply and Water Pollution Control Research.

C. Mervin, Palmer, and William M. Ingram.

In: Biology of water pollution, p 79-83. 1 fig, 1 tab, 24 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Algae, *Protozoa, *Systematics, *Sanitary engineering, Microorganisms, Nuisance algae, Sewage treatment, Self-purification, Dissolved oxygen, Photosynthesis.

Identifiers: *Pigmented flagellates, *Non-pigmented flagellates.

To meet the taxonomic requirements of sanitary scientists regarding the demarcation line between algae and protozoa, it is recommended to separate the flagellates on the basis of their ability to produce oxygen. Accordingly, the flagellates with photosynthetic pigments would be algae, and

without the pigments—protozoa. A list of flagellates of algal and protozoan types is included. (See also W72-01786) (Wilde-Wisconsin) W72-01798

ECOLOGY OF ANIMAL SAPROBIA,

R. Kolkwitz, and M. Marsson.

In: Biology of water pollution, p 85-95. 23 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Trophic level, *Water quality, *Self-purification, *Aquatic animals, Decomposing organic matter, Chemical properties, Measurement, Bioindicators, Systematics, Eutrophication. Identifiers: *Saprobiosis, Saprobic zones.

The following zones inhabited by aquatic animals which contribute to self-purification of polluted waters are described: oligosaprobic, alpha- and beta-mesosaprobic, and polysaprobic. This classification is based on organisms dependent on decomposing organic matter, or saprobes, and is essentially similar to the more recent subdivision of aquatic habitats into oligo-, meso-, and eutrophic waters. A list of organisms belonging to each subdivision is included. (See also W72-01786) (Wilde-Wisconsin) W72-01799

VALUE OF THE BOTTOM SAMPLER IN DEMONSTRATING THE EFFECTS OF POLLUTION ON FISH-FOOD ORGANISMS AND FISH IN THE SHENANDOAH RIVER,

Fish and Wildlife Service, Kearneysville, W. Va. Crosswell Henderson.

In: Biology of water pollution, p 96-107. 4 fig, 5 tab, 18 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Water pollution effects, *Fish, *Fish food organisms, *Sampling, Benthic fauna, Aquatic life, Surveys, Industrial wastes, Data collections. Identifiers: Shenandoah River (Va), Surber bottom sampler, Ekman dredge, Peterson dredge, Pollution surveys.

Standard physical, chemical, and bacteriological analyses do not necessarily present the true picture of fish and other aquatic animals in polluted waters. The lower part of the Shenandoah River is relatively free from pollution, as determined by standard procedures; yet, its aquatic animals are nearly exterminated by toxic industrial wastes. The Surber bottom sampler is a simple tool which permits determination of the source and extent of pollution as revealed by the density of fish food organisms. (See also W72-01786) (Wilde-Wisconsin) W72-01800

AQUATIC ORGANISMS AS AN AID IN SOLVING WASTE DISPOSAL PROBLEMS,

Academy of Natural Sciences, Philadelphia, Pa. Dept. of Limnology. Ruth Patrick.

In: Biology of water pollution, p 108-110. 6 ref, discussion. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Bioassay, *Aquatic life, *Waste disposal, *Water pollution effects, Food chains, Bacteria, Degradation (Decomposition), Algae, Oxygenation, Self-purification, Laboratory tests, Invertebrates, Fish, Water analysis, Insects, Snails, Toxicity, Rivers, Histograms. Identifiers: *River surveys.

Several laboratory tests or bioassays, supplementing determinations of oxygen demands, are described as aids in solving waste disposal problems. The suggested test organisms include fish, insects, snails, and algae, particularly Nitzschia linearis. These tests are intended primarily

to detect the toxicity of pollutants. The second approach, the biological survey of rivers, comprises identification of all aquatic organisms, total bacterial and coliform counts, and the determination of BOD and other chemical characteristics of water. (See also W72-01786) (Wilde-Wisconsin) W72-01801

EFFECT OF SILTATION, RESULTING FROM IMPROPER LOGGING, ON THE BOTTOM FAUNA OF A SMALL TROUT STREAM IN THE SOUTHERN APPALACHIANS,

North Carolina Wildlife Resources Commission, Hoffman.

L. B. Tebo, Jr.

In: Biology of water pollution, p 114-119. 3 fig, 2 tab, 7 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Water pollution effects, *Siltation, *Benthic fauna, *Lumbering, Fisheries, Land use, Trout, Turbidity, Streams, Fish food organisms, Erosion, North Carolina.

Identifiers: Coweeta Experimental Forest (N C), Shope Creek (N C), Log skid trails.

A small trout stream, Shope Creek, North Carolina, which drains a 1880 acre watershed, was damaged by logging conducted without drains, road surfacing, and using skid trails parallel and adjacent to the channel of the drainage stream. The subsequent erosion increased turbidity of the stream, accumulated sediment, and depleted the crop of bottom organisms. (See also W72-01786) (Wilde-Wisconsin) W72-01802

STREAM LIFE AND THE POLLUTION ENVIRONMENT,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Alfred F. Bartsch, and William M. Ingram.

In: Biology of water pollution, p 119-127. 8 fig, 16 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Water pollution effects, *Streams, *Aquatic life, *Model studies, Sewage, Environmental effects, Oxygen sag, Biochemical oxygen demand, Dissolved oxygen, Light, Photosynthesis, Respiration, Sampling, Organic matter, Eutrophication, Aquatic plants, Aquatic animals.

The effects of stream pollution by raw domestic sewage are schematically illustrated by a series of time-space diagrams. Drawings reveal the impact of the discharged sewage on DO and BOD under different levels of oxygenation and light, nitrogen and carbon, and the biomass of sewage molds, algae, bacteria, ciliates, rotifers, crustaceans, fish, worms, and arthropods. The transformations are extended to 9 days and 108 miles. (See also W72-01786) (Wilde-Wisconsin) W72-01803

DETECTION AND MEASUREMENT OF STREAM POLLUTION,

Bureau of Fisheries, Washington, D. C. Interior Fisheries Investigations; and Missouri Univ., Columbia Washington, D.C. Dept. of Physiology.

M. M. Ellis.

In: Biology of water pollution, p 129-185. 22 fig, 14 tab, 106 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Water pollution effects, *Streams, *Measurement, *Investigations, *Fisheries, On-site investigations, Data collections, Mud, Plankton, Mussels, Fish, Equipment, Dissolved oxygen, Hydrogen ion concentration, Laboratory tests, Ions, Conductivity, Inorganic compounds, Carbon dioxide, Test procedures, Carbonates, Iron, Ammonia, Suspended load, Depth, Bottom sediments,

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

Environmental effects, Toxins, Acids, Physical properties, Chemical properties.
Identifiers: *Chemical compounds' lethal limit.

An extensive summary (published in 1937) is presented of findings from the widely scattered literature and results of experimental work performed by the Interior Fisheries Investigations, U.S. Bureau of Fisheries. The major sections of the treatise include physical and chemical characteristics of waters favorable for freshwater stream fishes, effects of pollutants on fishes, and lethality of chemical ingredients in pollutants. Lethal limits of 114 substances are listed and a map showing surveyed rivers and major base points of the USA is included. (See also W72-01786) (Wilde-Wisconsin) W72-01804

THE EFFECTS OF SEWAGE POLLUTION ON THE FISH POPULATION OF A MIDWESTERN STREAM,

Public Health Service, Cincinnati, Ohio. Biology Section.
Max Katz, and Arden R. Gaufin.
In: Biology of water pollution, p 186-192. 1 fig, 3 tab, 4 ref. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Water pollution effects, *Fish, *Sewage, Ecological distribution, Distribution patterns, Limiting factors, Sampling, Methodology, Ohio.
Identifiers: Lytle Creek (Ohio).

The septic areas, immediately below discharged effluent of partially treated domestic sewage, were free of fish. At distances of 2, 3, and 4.4 miles below the outfall, an average of 2.2, 10.8, and 127 specimens of fish were taken per collection with two nets. In the clean water zone, 294 specimens of 36 species were taken per collection. Black bass and species of darters were highly sensitive to sewage. In spite of an adequate level of dissolved oxygen during winter, the fish did not invade the polluted water. (See also W72-01786) (Wilde-Wisconsin) W72-01805

THE EFFECTS OF ACID MINE POLLUTION ON THE FISH POPULATION OF GOOSE CREEK, CLAY COUNTY, KENTUCKY,

Kentucky State Dept. of Fish and Wildlife Resources, Frankfort.
William R. Turner.
In: Biology of water pollution, p 192-193. 3 tab. Compiled by L E Keup, W M Ingram, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Value, *Acid mine water, *Water pollution effects, *Fish populations, Fishkills, Electrical shocking gear, Fish, Sampling, Economics, Creel census, Sport fish, Fishing, Ponds per acre, Kentucky.
Identifiers: *Economic loss, Goose Creek (Ky), Kentucky River (Ky), Game fish, Rough fish, Pan fish.

To appraise the effect of acid mine water discharged into a creek from a coal mine, the density of fish population was recorded by utilizing an electric shocker. The yield in the unpolluted part of the creek averaged 61.3 lbs/acre, whereas that in the polluted part only 5.38 lbs/acre. About 70% of shocked fish were recovered. The minimum economic loss caused by the pollution of the creek was estimated to be \$13,325. (See also W72-01786) (Wilde-Wisconsin) W72-01806

WATER QUALITY REQUIREMENTS FOR RECREATIONAL USES,

Public Health Service, Washington, D C.

For primary bibliographic entry see Field 05G.

WATER POLLUTION, ITS EFFECT ON PUBLIC HEALTH,

Ohio State Dept. of Health, Columbus.

John D. Porterfield.

In: Biology of water pollution, p 198-201. Compiled by W M Ingram, L E Keup, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Water pollution effects, *Public health, *Water treatment, *Potable water, Ohio River, Industrial wastes, Water pollution sources, Economic impact, Ohio, Chlorination, Toxins, Taste, Odor, Legislation, Permits, Sewage.
Identifiers: Ohio Water Pollution Control Act.

Water pollution exerts both direct and indirect effects on human health. The indirect effects comprise curtailment of industrial development with subsequent unemployment, and the loss of recreational areas. The direct effect is primarily confined to the supply of drinking water. About 75% of Ohio residents obtain their drinking water from sources which daily receive a billion gallons of sewage and industrial waste. Neither chlorination nor bacteriological control deserve too much confidence in their efficiency as indicated by outbreaks of gastroenteritis. Water treatment works do not remove industrial wastes' toxicants whose cumulative effects on human physiology are not well known. (See also W72-01786) (Wilde-Wisconsin) W72-01808

POTENTIAL PLANT PATHOGENIC FUNGI IN SEWAGE AND POLLUTED WATER,

Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio. Water Supply and Water Pollution Program.

William B. Cooke.

In: Biology of water pollution, p 201-206. 3 tab, 17 ref. Compiled by W M Ingram, L E Keup, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Sewage effluent, *Irrigation water, *Pathogenic fungi, Crops, Plant pathology, Aquatic environment, Soil fungi, Systematics, Public health.

Identifiers: Columbia Basin (Ohio), Crop diseases, Fusarium solani, Fusarium oxysporum, Great Miami River (Ohio).

Sewage in various stages of treatment is used to supplement artificial irrigation of farm crops. Examination of sewages and polluted waters revealed the presence of many viable and spore forming fungi, including Fusarium solani, Fusarium oxysporum, and other species that are capable of attacking plants in the field, in harvesting, in storage, in transit, and on the market. Control measures applied to effluents may result in an adequate control of not only plant parasites, but also human pathogens. (See also W72-01786) (Wilde-Wisconsin) W72-01813

WATER-BORNE TYPHOID EPIDEMIC AT KEENE, NEW HAMPSHIRE,

New Hampshire State Dept. of Health, Concord. William A. Healy, and Richard P. Grossman.

In: Biology of water pollution, p 207-214. 1 fig, 4 tab, 2 ref. Compiled by W M Ingram, L E Keup, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Epidemiology, *Water supply, *Runoff, Water pollution effects, Human diseases, Coliforms, Filtration, Chlorination, Salmonella, Watersheds (Basins), New Hampshire.
Identifiers: *Typhoid, Keene (N H), Salmonella typhi.

The 1959 typhoid epidemic at Keene, New Hampshire, was inflicted by an improperly maintained small logging camp whose human wastes infested, via runoff, the city water supply with Salmonella typhi Phage Type E. This organism was recovered from one of the lumberjacks who was

the carrier, as well as the typhoid patients. The relatively limited incidence of the disease is attributed to filtration facilities that acted as a barrier and dilution by heavy rainfall. (See also W72-01786) (Wilde-Wisconsin) W72-01810

TRANSFORMATIONS OF IRON BY BACTERIA IN WATER,

New Jersey Agricultural Experiment Station, New Brunswick.

For primary bibliographic entry see Field 02K.

W72-01811

CHEMICAL COMPOSITION OF ALGAE AND ITS RELATIONSHIP TO TASTE AND ODOR,

Michigan Univ., Ann Arbor. School of Public Health.

For primary bibliographic entry see Field 05A.

W72-01812

AQUATIC BIOLOGY AND THE WATER WORKS ENGINEER,

James B. Lackey.

In: Biology of water pollution, p 236-239. Compiled by W. M. Ingram, L. E. Keup, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967. 9 fig.

Descriptors: *Sanitary engineering, *Water supply, *Biological properties, *Water pollution sources, Taste, Odor, Algae, Reservoirs, Watersheds (Basins), Insecticides, Hardness (Water), Diatoms, Fouling, Plankton, Sewage, Domestic waste, Industrial wastes, Farm wastes.

Identifiers: *Biological problems, Scioto River (Ohio), Lake Mendota (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis).

An engineer proposing to use river or lake water for the needs of a city or an industry should consider the pertinent physical, chemical, and biological properties of the water. The use of water for either human or industrial consumption may be precluded by a number of unfavorable characteristics, such as high concentration of nitrates, phosphates, sewage, and subsequent algal blooms, abundant plankton with its high BOD and filter clogging potential, the presence of pesticides, toxic industrial wastes, or pathogenic organisms. (See also W72-01786) (Wilde-Wisconsin) W72-01813

PRE-TREATMENT BASIN FOR ALGAE REMOVAL,

Menasha Electric and Water Utilities, Wis.

For primary bibliographic entry see Field 05F.

W72-01814

INDUSTRIAL WASTES AS A SOURCE OF TASTES AND ODORS IN WATER SUPPLIES,

Illinois Univ., Urbana. Dept. of Chemistry; and Illinois Water Survey, Urbana.

A. M. Boswell.

In: Biology of water pollution, p 244-246. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967.

Descriptors: *Water supply, *Industrial wastes, *Odor, *Water pollution sources, Taste, Decomposing organic matter, Phenols, Chlorination, Detergents, Sulfates.

Identifiers: *Odorophore groups.

The odor of water supplies may originate from wastes of many industrial processes, such as manufacturing organic products, production of chemicals, particularly synthetic detergents, and processing of food, beverages, textiles, leather, paper, and strawboard. Putrefaction of organic wastes and a high water content of sulfates intensify the obnoxious odor by formation of skatol, amines, hydrogen sulfide, and other sulfur compounds.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Effects of Pollution—Group 5C

Many of these wastes, as well as those of petroleum, steel, and phosphate industries, impart salty, sour, or bitter tastes to water. (See also W72-01786) (Wilde-Wisconsin)
W72-01815

THE CHEMISTRY AND BIOLOGY OF MILK WASTE DISPOSAL,
State Board of Health, Madison, Wis.
For primary bibliographic entry see Field 05D.
W72-01816

PROTOZOA AND ACTIVATED SLUDGE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 05D.
W72-01817

BIOLOGICAL FACTORS IN TREATMENT OF RAW SEWAGE IN ARTIFICIAL PONDS,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio; and South Dakota State Coll., Brookings. Dept. of Zoology.
For primary bibliographic entry see Field 05D.
W72-01818

TRICKLING FILTER ECOLOGY,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
For primary bibliographic entry see Field 05D.
W72-01819

SELECTION AND ADAPTATION OF MICROORGANISMS IN WASTE TREATMENT,
For primary bibliographic entry see Field 05D.
W72-01820

DISSOLVED OXYGEN VARIATIONS IN STRATIFIED LAKES,
Oregon State Univ., Corvallis.

David A. Bella.
Journal, Sanitary Engineering Division, Proceedings, American Society of Civil Engineers, Vol 96, No SA 5, October 1970, p 1129-1146. 11 fig. 16 ref.

Descriptors: *Lakes, *Stratification, *Dissolved oxygen, *Mathematical models, Hypolimnion, Epilimnion, Profiles, Mixing, Homogeneity, Temperature, Aeration, Photosynthesis, Oxygenation, Dispersion, Monitoring, Instrumentation, Water quality control, Water pollution effects, Washington.
Identifiers: *Lake Sammamish (Wash).

A mathematical model of lake dissolved oxygen was developed to include variations with depth and time. The combined effects of reaeration, photosynthetic oxygenation, vertical mixing and oxygen uptake were accounted for in the set of equations. Limitations of the derived model include the assumption that horizontal mixing is sufficient to keep the surface well mixed and essentially homogeneous. Therefore, any changes which occur in particular areas in less time than is required for homogeneous horizontal mixing will not be accurately described by the model. Data from Lake Sammamish, Washington were utilized to study the DO variations typical of many stratified lakes. Temperature profiles were used to estimate vertical dispersion coefficients, and bottom respirometer methods were used to determine benthic demands for oxygen, suspected as being possibly the principle reason for hypolimnetic DO depletion during summer months. Both vertical dispersion and hypolimnetic respiration were shown by the model to have a greater influence on hypolimnetic change during the summer than either photosynthetic oxygenation or reaeration. (Lowry-Texas)
W72-01864

CHEMISTRY OF NITROGEN AND PHOSPHORUS IN WATER.
American Water Works Association, New York. Water Quality Div. Committee on Nutrients in Water.

Descriptors: Waste water treatment, Water treatment, *Algae, *Eutrophication, *Nitrogen, Nitrogen cycle, *Phosphorus, Phosphorus compounds, Water supply, Water management.

Of the major elements essential to algal growth, nitrogen and phosphorus are the ones most likely to be found in limited quantities in natural waters. Since they therefore represent promising weak links in algal life cycles, their chemical states and behavior in water are examined to see how water treatment might benefit. Large supplies of nitrogen and phosphorus are present in many bodies of water either in the sediments, the atmosphere above, or in the form of dissolved gas. These forms may be available for the growth of algae and other aquatic plants, but the rates at which they become available is slow. These rates are important, however, as they tend to control the amount of vegetative growth which can be supported. Soluble nitrogen and phosphorus contained in wastewater effluents are in a readily available form. If discharged to natural waters, they can stimulate growth far in excess of that which would occur naturally. Thus, in assessing the extent of nutrient-related problems and their control, the water manager must evaluate the significance of the readily available forms and also the forms which may be released slowly from the suspended particles and the sediments. To do this, the body of water must be considered a chemical reactor which is controlled by the kinetics of a number of processes. (Goessling-Texas)
W72-01867

OXYGEN REQUIREMENTS OF SOME MARINE AND ANADROMOUS FISHES, WITH PARTICULAR REFERENCE TO PROBLEMS OF MEASUREMENT,

Southeastern Massachusetts Technological Univ., North Dartmouth.
J. Hoff, J. R. Westman, and M. E. Chittenden. Proceedings, Industrial Waste Conference, 21st, May 3, 4, and 5, 1966, p 125-140, 7 fig, 6 tab, 7 ref.

Descriptors: *Oxygen requirements, *Anadromous fish, *Water pollution effects, *Dissolved oxygen, *Lethal limit, *Fishkill, Water quality, *Standards, Legislation, Laboratory tests, Nitrogen, Estuaries, Toxicity, Fish.

Identifiers: Menidia menidia, Pseudopleuronectes americanus, Spherooides maculatus, Alosa sapidissima.

Our coastal estuaries, and in some cases, the rivers that enter them, have recently come into focus as environments that are vital to most of our Atlantic food and game fishes at some stage—or stages—in their life cycles. The environmental changes that may result from dredging, deposition of spoil on the wetlands, warm water discharges from generating plants, sewage disposal and other forms of pollution have aroused a national concern for these habitats. A study has been undertaken to determine the oxygen requirements of these marine fishes and one species of anadromous fish—all of which make vital use of estuarine waters. Fish were placed in aquaria and acclimated for varying periods of time as specified DO levels. Oxygen levels were reduced by bubbling nitrogen gas through the water and survival rates at various DO levels determined. It was found that the lethal oxygen level was not a fixed value that could be determined, in part by environmental and/or physiological factors such as temperature and stress. Therefore, when oxygen standards are to be established for a body of water, it should be high enough to allow some leeway for at least these factors. (Goessling-Texas)
W72-01875

AEROBIC DECOMPOSITION OF ALGAE,
Stanford Univ., Calif.
For primary bibliographic entry see Field 05D.
W72-01881

STUDIES ON FRESHWATER BACTERIA: EFFECT OF MEDIUM COMPOSITION AND METHOD ON ESTIMATES BACTERIAL POPULATION,
Freshwater Biological Association, Westmorland (England).

J. G. Jones.
J Appl Bacteriol. 33 (4): 679-686. 1970.
Identifiers: Bacteria, Bacterial, Composition, Fresh, Medium, Plate, Population, Spread, Surface.

The effects of various inorganic and organic components used in media for estimating numbers of freshwater bacteria were determined. The inorganic elements appeared to affect the count obtained more than did the organic components. Of the media tested, none could support growth better than the casein-peptone-starch medium of this laboratory. The casein and glycerol concentration was optimal and variation in other organic components had little effect on counts. The surface spread plate was the most suitable method of estimating viable numbers and the effect of numbers of colonies counted on the distribution obtained is discussed.—Copyright 1971, Biological Abstracts, Inc.
W72-01956

CHARACTERISTICS AND POLLUTION PROBLEMS OF IRRIGATION RETURN FLOW,
Utah State Univ., Foundation, Logan.

For primary bibliographic entry see Field 05B.
W72-01984

THE BARGED OCEAN DISPOSAL OF WASTES: A REVIEW OF CURRENT PRACTICE AND METHODS OF EVALUATION,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Lab.

B. D. Clark, W. F. Rittall, D. J. Baumgartner, and K. V. Byram.
Available from the National Technical Information Service as PB-204 868, \$3.00 in paper copy, \$0.95 in microfiche. Interim report, July 1971. 120 p, 27 fig, 9 ref. EPA Program 16070PGY.

Descriptors: *Sludge disposal, *Disposal, Oceans, Evaluation, Mathematical models, Waste disposal, Solid wastes.
Identifiers: *Barge dumping.

A broad scope examination was made of barged ocean disposal of liquid and solid wastes. Basic discussions include: the physical characteristics of various selected wastes, economics as a function of haul distance, reported effects of past discharge operations and the relative importance of environmental factors such as density and current profiles. The major emphasis of the report centers on physical fate prediction methods and describes the physical transport in four separate steps: convective descent, collapse, long term dispersion, and bottom transport or resuspension. An existing mathematical model developed by Koh and Fan is used and demonstrates the complex nature of some of the more obvious parameters, the potential usefulness of the approach to coastline management efforts while serving as a vehicle for the discussion of current state of the art limitations and research needs. (EPA Abstract)
W72-01987

TEMPERATURE REQUIREMENTS FOR GROWTH AND SURVIVAL OF LARVAL CISCOS (COREGONUS ARTED II),
Environmental Protection Agency, Duluth, Minn. National Water Quality Lab.
J. Howard McCormick, Bernard R. Jones, and Roll F. Syrett.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

Journal of the Fisheries Research Board of Canada. Vol 28, No 6, p 924-927, 1971. 1 fig, 1 tab, 22 ref. EPA Program 18050 WAA.

Descriptors: *Water temperature, *Juvenile fishes, *Growth rates, *Cisco, *Limiting factors, Thermal pollution, Fry, Larvae, Biomass.

Identifiers: Year-class-strength, Recruitment.

Temperatures above 13 and below 18 C are recommended as most suitable for sustained production of larval cisco, as indicated by instantaneous rates of growth, mortality, and net biomass gain in cisco reared at seven constant temperatures from 3 to 21 C. Growth rates increased in the temperature range from 3 through 18 C. Net rates of biomass gain were maximum at 13 through 18 C. The 24-hr median lethal temperature for ciscos acclimated to 3 C was calculated to be 19.8 C. (EPA Abstract) W72-01989

EUTROPHICATION: SMALL FLORIDA LAKES AS MODELS TO STUDY THE PROCESS, Florida Univ., Gainesville. Dept. of Environmental Engineering. For primary bibliographic entry see Field 05B. W72-01990

APPLICATION OF MATHEMATICAL MODELS TO THE EUTROPHICATION PROCESS, Florida Univ., Gainesville. Dept. of Environmental Engineering. Gainesville, Florida, Environmental Engineering Department. For primary bibliographic entry see Field 05B. W72-01991

A PARTIAL CHECKLIST OF FLORIDA FRESH-WATER ALGAE AND PROTOZOA WITH REFERENCE TO MCCLOUD AND CUE LAKES, Florida Univ., Gainesville. Dept. of Environmental Engineering. For primary bibliographic entry see Field 05A. W72-01993

OBSERVATIONS OF THE MUD-WATER INTERFACE, Georgia Univ., Athens. Dept. of Zoology. For primary bibliographic entry see Field 02H. W72-02025

ORGANIC-INORGANIC ASSOCIATIONS: THEIR FORMATION AND INVOLVEMENT IN NUTRIENT MOBILIZATION FROM THE SEDIMENTS OF LAKES, Georgia Univ., Athens. Dept. of Zoology. For primary bibliographic entry see Field 02H. W72-02025

OXIDATION-REDUCTION DETERMINATIONS AT THE MUD-WATER INTERFACE, Georgia Univ., Athens. Dept. of Zoology. For primary bibliographic entry see Field 02H. W72-02024

COMPLEX-USE MANAGEMENT OF THE KARASUK-BURLA LAKES (KOMPLEKSNYE KHOZYAYSTVENNOYE ISPOL'ZOVANIYE KARASUKSKO-BURLINSKIKH OZER), Novosibirsk Pedagogical Inst. (USSR). For primary bibliographic entry see Field 04A. W72-02069

THE ANACOSTIA RIVER, ECOLOGICAL IMBALANCE OF AN URBAN STREAM VALLEY, National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center. R. F. Mueller, and R. M. Lahn. National Aeronautics and Space Administration Technical Memorandum X-65549, December 1970. 28 p, 11 fig, 21 ref.

Descriptors: *Urbanization, *Water pollution sources, *Water pollution effects, *Ecology, *District of Columbia, Cities, Rivers, Land development, River basins, Sediment transport, Industrial wastes, Municipal wastes, Construction, Ecosystems, Water quality, Floods, Runoff. Identifiers: *Urban hydrology (DC), *Anacostia River (DC).

The Anacostia River, a branch of the Potomac, flows in the eastern part of the District of Columbia, and in adjacent suburban Prince George's and Montgomery Counties. It is in many ways a prototype of the urban stream showing severe ecological imbalances resulting from intensive and unplanned land use and the general impact of technology. The Anacostia River Valley is out of balance with respect to stresses placed upon it by ungoverned technological expansion. Symptoms of this imbalance are widespread biological, chemical and physical pollution as well as destructive land use and hydrologic practices. As a result the regimen of the river is in continuous transition and its great potential as an environmental asset is being lost to the nearly one million inhabitants of the basin. Instead it has become an enormous burden and threat to the health and well-being of these inhabitants. The environmental deterioration will lead to high tax burdens for years to come. (Woodard-USGS) W72-02093

MICROFUNGI IN THE WATER, MUD, AND LITTER OF A CATTAIL MARSH, Wisconsin State Univ., Oshkosh. Dept. of Biology; and Wisconsin Univ., Madison. Water Resources Center.

Leonard L. Tews. In: Proceedings 13th Conference Great Lakes Res., 1970, 106-113, International Association Great Lakes Research. 8 p, 1 fig, 4 tab, 33 ref.

Descriptors: *Isolation, *Phytoplankton, *Eutrophication, *Aquatic fungi, Wisconsin, Lakes, Fungi, Microorganisms, Marshes, Freshwater marshes.

Identifiers: *Phytobenthos, *Microfungi, Lake Butte des Morts (Wis), *Microfungi.

Microfungi were isolated from the water, litter, and mud of a cattail marsh bordering Lake Butte des Morts, a lake within the Fox-Wolf River system of Central Wisconsin. Thirty-six taxonomic entities were isolated including 23 molds and 13 yeasts. The most frequently isolated fungi were Trichoderma viride Pers ex Fries, Mucor hiemalis Wehmer, Penicillium stipitatum Thom, and Hansenula saturnus (Klocke) H. and P. Sydow. Neither a trapping of aquatic Zoosporic fungi nor a rigorous elimination of air-borne forms was attempted. (W72-02112)

THE RESPONSE OF A SPECIALIZED AQUATIC ECOSYSTEM, THE DUCKWEED RHIZOSPHERE, TO SELECTED ENVIRONMENTAL INFLUENCES, Massachusetts Univ., Amherst. Inst. of Agricultural and Industrial Microbiology.

R. A. Coler, and H. B. Gunnar. Water Research, Vol 5, p 329-333, 1971. 2 tab, 7 ref. OWRR A-047-MASS (1).

*Ecosystems, *Biological communities, *Aquatic environment, *Rhizosphere, Bacteria, Nematodes, Water quality, Stress, Biota, Herbivores, Laboratory tests, Predation, Fish, Protozoa, Food chains, Biomass.

Identifiers: *Ecosystem stress, *Duckweed, *Lemna minor, Lebistes reticulatus, Oscillatoria, Os-tracods, Ecosystem dynamics, Euploites.

A readily accessible microbiocoenosis is provided by the duckweed rhizosphere where the constituent populations may be maintained, observed, and sampled without doing violence to their microenvironment. This tool provides a measure of total community response enabling investigators to use

this to gauge a selected ecosystem stress. The duckweed rhizosphere (*Lemna minor*) was exposed to two environmental stresses: predation by guppy fry (*Lebistes reticulatus*) which limits biomass directly and inhibition by *Oscillatoria* which affects the rhizosphere both directly through the aquatic milieu and indirectly through disruption of plant metabolism. The resultant shifts in community composition were recorded and compared to control populations. While feeding changed community composition, it did not reduce variability. *Oscillatoria* growth imposed severe environmental limits that disrupted community structure. The rhizosphere of *Lemna minor* may provide an index sufficiently sensitive to reflect subtle shifts in water quality and indicate broad environmental pressures. Significance of these results would appear to lie in the use of an entire biota as a bioassay system rather than the classical resort to 'universal indicator species'. (Jones-Wisconsin) W72-02114

AMOUNT OF PIGMENTS AND DAILY PRODUCTION OF PHYTOPLANKTON OCCURRING IN ACIDIC LAKE TOYA (IN JAPANESE), Hokkaido Univ. (Japan). Faculty of Fishery. Teruyoshi Kawamura, and Satoru Taguchi. Bull Fac Fish Hokkaido Univ. 21 (3): 201-209. Illus. 1970. English summary.

Identifiers: Acidic, Chlorophylla, Daily, Japan, Lake, Phaeophytin, Photosynthesis, Phyto, Pigments, Plankton, Production, Toya.

This paper deals with the amount of pigments, chlorophyll a and pheophytin, and the daily production of phytoplankton in Lake Toya. The amount of chlorophyll a and pheophytin in the euphotic zone showed 6.01-10.24 mg chlorophyll a/sq m and 3.02-12.76 mg pheophytin/sq m. The ratio of pheophytin to chlorophyll a in the euphotic zone ranged from 0.5 to 1.6. In comparison with that of Lake Shikotsu (oligotrophic lake) and Lake Onuma (eutrophic lake), the high ratio of pheophytin to chlorophyll a leads to the conclusion that the phytoplankton occurring in Lake Toya contains an excess of pigments in primary production. The photosynthetic activity of chlorophyll a in this lake is not always low as compared with some oligotrophic lakes of central Japan. In short, it seems that the small amount of chlorophyll a of phytoplankton is responsible for the low degree of primary production in Lake Toya. Copyright 1971, Biological Abstracts, Inc. W72-02197

LIMNOLOGICAL STUDIES OF LAKE NORRViken, A EUTROPHICATED SWEDISH LAKE: II. PHYTOPLANKTON AND ITS PRODUCTION, Uppsala Univ. (Sweden). Inst. of Limnology. Gunnel Ahlgren.

Schweiz Z Hydrol. 32 (2): 353-396. Illus. 1970. Identifiers: Aphanizomenon-Flos-Aquae, Cryptomonads, Diatoms, Eutrophication, Lakes, Limnological, Norrviken, Oscillatoria-Agarthii, Phyto, Plankton, Production, Sewage, Succession, Swedish.

Phytoplankton and its production were studied for 1 yr in Lake Norrviken (central Sweden) which has long been the recipient of sewage waste, mainly from a yeast factory. The investigation was primarily intended to give a quantitative picture, and therefore only the most frequently occurring genera and species were counted. Seasonal succession of the more important groups of algae is demonstrated. The most important group was the cyanophyceans with *Aphanizomenon flos aquae* and *Oscillatoria agarthii* as the dominating species. These species dominated from July until Oct. with a maximal development at the end of July and beginning of Aug. During the late autumn and winter complete dominance was attained by some species belonging to the cryptomonads. The diatoms had a short maximum in May and the green algae a maximum in June. Factors influencing the succession are discussed. The most important factors for the plankton succession are

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Waste Treatment Processes—Group 5D

probably the hydrographical conditions.—Copyright 1971, Biological Abstracts, Inc.
W72-02199

BLUE-GREEN ALgal EFFECTS ON SOME HYDROLOGIC PROCESSES AT THE SOIL SURFACE,

Arizona Univ., Tucson. Water Resources Research Center.

For primary bibliographic entry see Field 02G.
W72-02218

5D. Waste Treatment Processes

BIOLOGICAL TREATMENT OF BEEF ANIMAL WASTES,

Kansas State Univ., Manhattan. Water Resources Research Inst.

L. A. Schmid, and R. I. Lipper.

Available from the National Technical Information Service as PB-204 704, \$3.00 in paper copy, \$0.95 in microfiche. Contribution No 77, 1971. 59 p, 17 fig, 12 tab. OWRR A-015-KAN (1).

Descriptors: *Anaerobic digestion, *Oxidation lagoons, *Farm wastes, *Waste water treatment, *Biological treatment, *Farm lagoons, Waste disposal, Irrigation, Water reuse, Anaerobic conditions.

Identifiers: *Beef animal wastes, Liquified manure.

An anaerobic digestion system and an oxidation ditch system were employed in this study to investigate the treatment, handling, and disposal of the confined beef animal wastes. Considering only acid fermentation, the process permits the use of the anaerobic digester under little skilled supervision for manure liquification. Uncontrolled field environmental factors, such as low temperatures, low pH, and intermittent and shock loading do not inhibit the acid forming bacterial activities which are responsible for liquifying the organic solids. The liquified manure is more readily degradable for further treatment, can be returned to the soil for agricultural irrigation, and has less pollutant strength for disposal on land. The anaerobic digestion system for solids liquification can be one answer to handling, holding, and disposing of the confined beef animal wastes. The oxidation ditch system, with a loading of one animal per 60 cu. ft. of liquid volume, provides a potential treatment of beef animal wastes. The two rotors in this system, with a speed of 200 r.p.m. and an immersion depth of 3 inches, are capable of maintaining adequate waste velocity and oxygenation.
W72-01777

THE CHEMISTRY AND BIOLOGY OF MILK WASTE DISPOSAL,

State Board of Health, Madison, Wis.

Theodore F. Wisniewski.

In: Biology of water pollution, p 247-252. Compiled by W. M. Ingram, L. E. Keup, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967. 3 fig.

Descriptors: *Waste treatment, *Microorganisms, *Bacteria, Trickling filters, Biodegradation, Biochemical oxygen demand, Proteins, Biochemistry, Protozoa, Sludge digestion, Activated sludge. Identifiers: *Milk wastes.

The essential features of the trickling filter and activated sludge units are reviewed and the mechanisms which permit a decrease of BOD of milk wastes by microbial oxidation of organic compounds. Purification of milk wastes is completed when the settled sludge is removed from the filter and digested by enzymes and transformed by anaerobic bacteria. Emphasis is placed on temperature, oxygen, and nutrient requirements of microorganisms. (See also W72-01786) (Wilde-Wisconsin)
W72-01816

PROTOZOA AND ACTIVATED SLUDGE,

Massachusetts Inst. of Tech., Cambridge. Dept. of Sanitary Engineering.

Ross E. McKinney, and Andrew Gram.

In: Biology of water pollution, p 252-262. Compiled by W. M. Ingram, L. E. Keup, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967. 7 fig, 1 tab, 18 ref.

Descriptors: *Sewage treatment, *Protozoa, *Activated sludge, *Bacteria, Metabolism, Growth rates, Microorganisms, Algae, Fungi, Laboratory tests, Biochemical oxygen demand, Sewage effluents, Sanitary engineering.

Identifiers: *Sarcodina, Mastigophora, Holozoic Mastigophora, Holophytic Mastigophora, Ciliata.

To delineate the role of protozoa in sludge activation, experiments were conducted under the concept of 'minimum conditions.' The latter were established by a combination of a balanced soluble substrate, bacteria from activated sludge, and a pure culture of protozoa. The floc formed was the result of metabolic activity of microorganisms in the mixed liquor. The flagellate and ciliate protozoa included Chilomonas paramaecium, Euglena gracilis, Tetrahymena filii, and Glaucina scintillans. The trials demonstrated the general principles of competition of protozoa with bacteria and the importance of protozoa in sludge activation. The succession of protozoa—Sarcodina, the holophytic and holozoic Mastigophora, and the free-swimming and stalked Ciliata—was established to serve as a guide to better operations. The bacterial flocculation was confirmed in the control unit. (See also W72-01786) (Wilde-Wisconsin)
W72-01817

BIOLOGICAL FACTORS IN TREATMENT OF RAW SEWAGE IN ARTIFICIAL PONDS,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio; and South Dakota State Coll., Brookings. Dept. of Zoology.

A. F. Bartsch, and M. O. Allum.

In: Biology of water pollution, p 262-269. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967. 6 fig, 7 tab, 18 ref.

Descriptors: *Sewage treatment, *Oxidation lagoons, *Algae, *Bacteria, *Dissolved oxygen, Sewage lagoons, Plant physiology, Animal physiology, North Dakota, South Dakota, Photosynthesis, Light penetration, On-site tests, Biochemical oxygen demand, Diurnal, Chlorophyll.

Identifiers: *Photosynthetic oxygen, Lemmon (SD), Kadoka (SD).

Freedom from nuisance conditions and the acceptability of raw sewage ponds to municipalities as treatment facilities are intimately dependent upon the dissolved oxygen supply in sewage. Light and dark bottle analyses and the estimated oxygen production based on Verduin's factor permit establishment of suitable loading and depth of sewage lagoons. The use of pond design equations, however, requires caution because profile variations, weather conditions, diurnal changes, and other factors may impose considerable deviation in design. (See also W72-01786) (Wilde-Wisconsin)
W72-01818

TRICKLING FILTER ECOLOGY,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

William B. Cooke.

In: Biology of water pollution, p 269-287. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967. 7 fig, 3 tab, 45 ref.

Descriptors: *Biological communities, *Sewage treatment, *Trickling filters, *Biota, Sewage bacteria, Systematics, Fungi, Algae, Diatoms,

Protozoa, Plankton, Worms, Nematodes, Rotifers, Larvae, Snails, Mites, Molds, Growth rates, Habitats.

Identifiers: *Zoogloal slime, Dayton (Ohio), Vandalia (Ohio), Rhizopods, Spiders, Milk waste treatment, Colony counts, Arthropods.

The populations of several trickling filters in the USA and England are reviewed. The compiled list of the common members of this man-made ecosystem, exceeding 200 species, includes herbivores, carnivores, and saprobes, serving as primary or secondary decomposers. This population effectively removes solids, colloids, and dissolved matter, thus reducing BOD of the sewage. No correlation between the surface growth and temperature or precipitation was observed. The functioning of the population depends largely on preformed organic matter. At death the organisms are attacked by scavengers and thus reenter the metabolic system. (See also W72-01786) (Wilde-Wisconsin)
W72-01819

SELECTION AND ADAPTATION OF MICROORGANISMS IN WASTE TREATMENT,

Paul W. Kabler.

In: Biology of water pollution, p 287-290. Compiled by L. E. Keup, W. M. Ingram, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967. 19 ref.

Descriptors: *Sewage treatment, *Biological communities, *Microorganisms, Waste treatment, Industrial wastes, Forage palatability, Macroenvironment, Biology, Genetics.

Identifiers: *Microbial adaptation, Mutants, Gene recombination, DNA transformation, DNA transduction.

All waste treatment processes comprise aggregate activity of a community of organisms transferring pollutant material into innocuous components. The members of these communities, numbering billions in trickling filters and sludge digestion tanks, are in a constant struggle for survival; the outcome is determined by the ability of competitors to utilize available waste material and to produce essential enzymes. The final specific composition of the community and its efficiency are likely to be influenced by mutation, gene recombination, and transfer and transduction of DNA. The degradation of resistant materials, such as alkyl benzene sulfonate and lignin, may be eventually achieved by selection of the 'most fit' progenitors, activation of latent enzyme systems, or chemical pretreatment. (See also W72-01786) (Wilde-Wisconsin)
W72-01820

A RATIONAL EVALUATION OF INSTRUMENTATION AND CONTROL SYSTEMS,

Maguire (Charles A.) and Associates, Inc., Waltham, Mass.

Russell H. Babcock.

Paper presented at the Annual Meeting of the Water Pollution Control Federation, October 3-8, 1971, San Francisco. 18 p, 4 fig, 2 tab, 8 ref.

Descriptors: *Waste water treatment, *Automatic control, *Electronic equipment, *Control systems, *Instrumentation, Remote control, Data transmission, Supervisory control, Model studies, Digital computers, Automation, Mechanical control, Treatment facilities, Water pollution control, Computers.

Identifiers: *Process control.

Current and potential applications of pneumatic and electronic instrumentation and control systems applicable in automating waste water treatment processes are discussed. Maintenance of the instruments in automated systems is a leading problem. The author suggests that this be handled by specialized companies, for large fully-automated treatment plants. The complex and varied nature of waste processing requires that a rational approach be made to adopting the correct class of instrumentation, starting with a complete understanding of

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

the processes and variables to be measured. Unless the problem of maintenance is tackled and set on a proper course, any progress in the use of electronics as opposed to pneumatics in instrumentation will be seriously retarded. The day of the completed computer-controlled facility is far off. At present, the role of these devices must be relegated to that of supervising. Insofar as the waste treatment process is concerned, the computer has arrived somewhat ahead of its time. Much has yet to be learned of the complexities surrounding the variables of the processes. The lack of knowledge imposes a serious limitation on their use and adaptation at the present time. The advent of Intrinsic Safety Standards can simplify and economize on installations in hazardous areas. Where this standard of equipment has been adopted, improved operating and maintenance conditions have resulted. (Poertner)

W72-01823

TOWARD COMPUTER CONTROL OF WASTE-WATER TREATMENT,

Philadelphia Water Dept., Pa.; and General Electric Co., Philadelphia, Pa.

Carmen F. Guarino, Harold D. Gilman, Michael D. Nelson, and Carl M. Koch.

Presented at the 44th Annual Conference, Water Pollution Control Federation, San Francisco, California, October 1971. 19 p, 7 fig, 2 tab, 13 ref.

Descriptors: *Automatic control, *Waste water treatment, *Digital computers, *Control systems, Remote sensing, Remote control, Research and development, Telemetry, Electronic equipment, Mathematical models, Model studies, Computers. Identifiers: *Computer control, *Philadelphia (Pa).

The various feasible approaches for automatic monitoring of the physical parameters that are significant in wastewater treatment and automatic central control of wastewater treatment plants are discussed. Computer control of wastewater treatment processes may be the only way to: satisfactorily cope with increasingly more stringent requirements of regulatory agencies, meet information requirements, optimize system operations, and combat today's rising operational costs. Computer process control requires: satisfactory sensors and instrumentation, communication equipment, electronic computers, and mathematical models. The chief technological obstacles to implementation of plant automation are the need for process sensors and process control models. Sensor probes need to be developed to detect the required plant operation variables and to operate reliably in the hostile sewage environment. Studies are described of possible ways to make rapid determinations of BOD₅ by relating it to measurable parameters such as total organic carbon and total oxygen demand. Mathematical models of treatment processes are needed to convert acquired data into plant controls. Computer hardware and communication equipment present no limitations. Philadelphia is preparing to rebuild its three wastewater treatment plants using the most effective treatment methods available along with associated automated procedures. Their first attempt involves 'near real time' digester automation at Philadelphia's Northeast Water Pollution Control Plant. This will be a major step toward sewage treatment plant automation. (Poertner)

W72-01824

INVENTORY AND PROBLEM DELINEATION, PHASE I REPORT, REGIONAL WATER SUPPLY AND WASTEWATER DISPOSAL STUDY.

Camp, Dresser and McKee, Inc., Boston, Mass. For primary bibliographic entry see Field 06D.

W72-01830

NUMERICAL SOLUTION OF FILTRATION EQUATIONS,

Bengal Engineering Coll., Howrah (India). Arun K. Deb.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No. SA 2, April 1970, p 195-210. 6 fig, 15 ref.

Descriptors: *Filtration, *Numerical analysis, *Mathematical models, Digital computers, Sands, Suspensions, Flow rates, Head loss, Pressure, *Waste water treatment.

Identifiers: Specific deposit, Boundary conditions.

Experiments were performed on a model filter to evaluate filtration parameters for a computer analysis of the filtration mechanisms. To conform to assumptions made in the derivation of the mathematical model, the suspension used was fairly unsize Fuller's earth of 6 micro mean particle size and having a density of 2.22 g/cc. Uniform sand beds 61 cm deep consisting of sands of mean sizes of 0.647 mm and 0.722 mm were used in a 10.16 x 10.16 cm plexiglass filter tube. Filtration rate was held constant, and sampling was designed to create the least disturbance to the filtration process. Solution of the nonlinear partial differential equations required the use of finite difference methods of numerical analysis programmed into a computer to provide theoretical values to check against experimental data. Suspension concentrations, specific deposit and head loss variations in a filter run can be obtained in this manner. The problem may be treated as a semi-infinite one, in which the boundary conditions at the upper boundary are only known and need be specified. The relatively simple numerical procedure and computational scheme described here-in are satisfactory. (Lowry-Texas)

W72-01841

MECHANISM AND KINETICS OF SUBSTRATE UTILIZATION AT HIGH BIOLOGICAL SOLIDS CONCENTRATIONS,

Oklahoma State Univ., Stillwater.

P. Krishnan, and A. F. Gaudy, Jr.

Proceedings, Industrial Waste Conference, 21st, May 3, 4, and 5, 1966, p 495-510. 8 fig, 1 tab, 23 ref.

Descriptors: *Waste water treatment, *Activated sludge, *Adsorption, Biodegradation, Laboratory tests, Oxygen demand, Nitrogen, Analytical techniques, Data collection.

Identifiers: *Biosorption, *Substrate removal.

There is still much controversy over the mechanism of purification during rapid substrate removal, i.e., adsorption of soluble substrate on the floc as opposed to metabolism as the primary mechanism of rapid substrate removal. A study was undertaken to gain further insight into the mechanisms of rapid substrate utilization at high solids concentration and also to investigate the degree of immediate uptake of substrate by the sludge. Two batch activated sludge units were used in this study using seed from the local treatment plant and fed on glucose and sorbitol. The results obtained in this study offer no evidence for adsorption as a primary mechanism of substrate removal, but do offer additional evidence for the purely biochemical mechanism. The results offer further proof of the hypothesis presented by Rao and Gaudy for the different mechanisms of substrate removal for low and high solid systems and offer a biochemical explanation for the occurrence of linear sludge accumulation and substrate removal and the change in percent of the theoretical oxygen demand exerted at the time of substrate removal at higher solids. (Goessling-Texas)

W72-01843

INKA AERATION AT HAZLETON, PENNSYLVANIA,

Gannett, Fleming, Corddry and Carpenter, Inc., Harrisburg, Pa.

Paul E. Paul.

Preprint, presented at Water Pollution Control Federation Conference, 44th, Session 8, No 4, October 5, 1971. 20 p, 6 fig, 1 tab.

Descriptors: *Aeration, *Activated sludge, *Mixing, Pressure, Operation and maintenance, Organic

loading, Temperature, Stainless steel, Municipal wastes, Industrial wastes, Toxicity, Heavy metals, Sludge disposal, *Waste water treatment, Treatment facilities.

Identifiers: *Oxygen transfer efficiency, *Inka aeration.

An activated sludge wastewater treatment plant equipped with shallow-depth, high-volume aeration equipment (Inka Aeration) was placed in operation in 1968. The system consisted of stainless steel diffuser grids providing oxygen for both mixing and aeration. Plastic baffles were used to ensure a rolling action of the wastes. Air volumes provided to the Inka system were approximately 4,400 cu ft/l BOD₅ applied as opposed to 1,500 cu ft for a conventional diffused air system. Static system pressures for the Inka were 2.5 ft H₂O compared to 13 ft H₂O for conventional aeration. However, the range of O₂ transfer efficiency was 1-2% for Inka Aeration and 4-6% for conventional aeration. Both aeration types required 0.03 hp per lb BOD₅. The Inka Aeration System has operated for 3 years with minimal difficulties. Little or no gridhole clogging has been observed, since the holes are larger and the volumes of air passing through are larger. If an aeration grid does require repairs, two men can lift it out and carry it to the shop since it weighs only 75 lbs. To perform a comparable service for diffused aeration requires the use of a winch to remove 400 lbs of pipe alone. Treatment efficiency has been excellent as long as toxic wastes do not interfere and high air volumes are supplied. 3 lbs of activated sludge are produced per lb BOD₅ stabilized, and this sludge is then incinerated. (Lowry-Texas)

W72-01844

THE DE-WATERING OF DIGESTED SLUDGE USING SYNTHETIC FILTERING AGENTS,

Stuttgart Univ. (West Germany).

For primary bibliographic entry see Field 05E.

W72-01846

REMOVAL OF ORTHOPHOSPHATES FROM AQUEOUS SOLUTIONS WITH ACTIVATED ALUMINA,

Northwestern Univ., Evanston, Ill.

Ronald D. Neufeld.

Master's Thesis, August 1968. 90 p, 25 fig, 14 tab, 29 ref.

Descriptors: *Phosphates, *Separation techniques, *Adsorption, Tertiary treatment, Diffusion, Saturation, Hydrogen ion concentration, Statistical analysis, Nitrates, *Waste water treatment.

Identifiers: *Activated alumina, *Reformation, Break-through curves, Capacity, *Orthophosphates.

Laboratory column experiments were conducted using activated alumina to remove orthophosphates from various solutions. Capacity of the alumina was found to be an analytic function of the inlet concentration, which was determined to follow a Langmuir type of equation. Breakthrough curves produced straight lines when plotted on probability paper, yielding the following relationship: $C/Co = 1/2 (1 - erf (mv .. k))$. Phosphate removals in excess of 99.9% were achieved over extended time periods for feed concentrations of 10 mg/l, 30 mg/l and 120 mg/l, far surpassing most of the presently available processes in use today. Orthophosphate removal is initially accompanied by an exchange of the nitrates present on the solid alumina. This step is then followed by consecutive reformations of the phosphate deposited on the solid surface with the phosphate in solution to effect its further removal. (Lowry-Texas)

W72-01847

OPERATING EXPERIENCES WITH VACUUM FILTRATION AT ST. HELENS: A SOLUTION TO THE PROBLEM,

P. S. Ashman, and P. F. Roberts.

Water Pollution Control, Vol 69, No 6, p 638-645, 1970. 5 fig, 2 tab, 4 ref.

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Waste Treatment Processes—Group 5D

Descriptors: *Sludge, *Vacuum drying, *Coagulation, Filtration, Separation techniques, Monitoring, Drying, Mixing, *Waste water treatment.
Identifiers: *Drum speed, *Solids content, Elutriation.

Vacuum filters operating at St. Helens have been unable to keep up with the inflow of sludge during certain times of the year, necessitating sludge storage in facilities designed for other uses. Investigations were performed to determine whether or not more optimal operating conditions could be reached. Flow rates of both elutriated sludge and coagulant flow were measured to enable dosage rates to be determined and varied for this investigation. A new dosing and mixing trough was designed and aluminum chlorhydrate was re-evaluated as a coagulant at various dose rates and three drum speeds. It was found that yield could be increased by increasing the speed of the filter drum and further increased by increasing the coagulant dose up to about 4% Al_2O_3 on dry solids. Maximum yields were 1.3 and 1.4 lb dry solids/sq ft-hr at a time when normal yields would be less than 1.0 lb dry solids/sq ft-hr. Use of aluminum chlorhydrate further increased yields to the extent that no polyelectrolytes were needed, and the filter was run only half the time due to lack of sludge. A method of determining filtration characteristics was tested and is also presented. (Lowry-Texas)

W72-01849

OXYGEN DIFFUSION THROUGH A PURE CULTURE FLOC OF ZOOGLOEAE RAMIGERA, Wisconsin Univ., Madison.

J. A. Mueller, E. N. Lightfoot, and W. C. Boyle. Proceedings, Industrial Waste Conference, 21st May 3, 4, and 5, 1966. p 964-995, 22 fig, 2 tab, 18 ref.

Descriptors: *Waste water treatment, *Waste assimilative capacity, *Oxygen requirements, Diffusion, Resistance, Particle size, Laboratory tests, Dissolved oxygen, Temperature, Bacteria.
Identifiers: *Floc particles, Rate limiting, *Zoogloea ramigera, Pure cultures.

A study has been undertaken to expand current knowledge of the mechanisms of oxygen supply to bacteria within a floc particle and to determine the role of oxygen diffusion through the floc particles. Small batch reactors in which DO and temperature were measured provided an environment for the oxygen uptake determinations of various size ZOOGLOEAE ramigera floc. It was found that: (1) dispersed cells had a critical oxygen concentration of 0.1 mg/l; (2) for floc particles to exhibit maximum oxygen uptake rates, the DO concentration must be 0.6 to 2.5 mg/l depending on the floc size; (3) diffusion of oxygen through the floc matrix is the controlling mechanism in the rate of oxygen utilization, when oxygen becomes limiting; (4) the resistance to oxygen transfer of the liquid film surrounding the floc is negligible when compared to the clump resistance of the cells and the floc; (5) the anoxic core model is adequate to determine oxygen diffusivity and the limiting oxygen concentration method is totally inadequate; (6) the specific surface floc measurements yield more accurate estimates of diffusional distances through the floc than do the nominal diameter floc measurements; (7) with nominal specific surface floc sizes, the average oxygen diffusivity values, D_w , were $2.1 \times 0.00001 \text{ sq cm/sec}$ at 30 deg C and $1.8 \times 0.000001 \text{ sq cm/sec}$ at 20 deg C; and, (8) diffusivity values, D_w were 25 times larger than D_s . (Goessling-Texas)

W72-01851

VIRUS INACTIVATION DURING PHOSPHATE PRECIPITATION,

Dept. of Health, Education and Welfare, Cincinnati, Ohio. Bureau of Solid Waste Management.

Dirk R. Brunner, and Otis J. Sproul.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA 2, April, 1970. p 365-379, 9 fig, 2 tab, 20 ref.

Descriptors: *Viruses, *Phosphates, *Chemical precipitation, Lime, Calcium, Aluminum, Hydrogen ion concentration, Adsorption, Water quality control, *Waste water treatment, Sludge disposal, Public health.
Identifiers: *Viral inactivation, *Alum.

Phosphate precipitation was studied to determine its effect on viruses in distilled water and domestic wastewater on a laboratory scale. Both calcium and aluminum were successful in removing large numbers of virus particles by phosphate precipitation in both the distilled water-phosphate media and the domestic wastewater treatment plant effluent. In both solutions, precipitation with aluminum at pH 5.0 and $\text{Al:PO}_4 = 1.0$ effected 90% virus inactivation on the removal of 24 mg/l PO_4 and 98% poliovirus inactivation when 30 mg/l of PO_4 were removed. Calcium treatment of the distilled water solution at pH 11.0 produced 97% virus inactivation with 37 mg/l PO_4 precipitated, and 94% virus inactivation of secondary effluent when 44 mg/l PO_4 was precipitated. It was discovered that virus removals for both methods could be predicted by use of a Freundlich isotherm. Alum was found superior to lime for viral removals, and removals with either process were sensitive to pH changes. Additional public health hazards are presented in disposing of phosphate reduction sludges. (Lowry-Texas)

W72-01852

ISLAND CITY SOLVES TOUGH SEWERAGE PROBLEM.

Public Works, Vol 101, No 2, p 95, February 1970. 1 fig.

Descriptors: *Waste water treatment, *Sewers, *Plastic pipes, Elevation, Sea level, Water table, Infiltration, Economic analysis, *Treatment facilities, Texas.
Identifiers: Package treatment plants, Lift stations, *Galveston (Tex).

The average elevation of Galveston, Texas is only 7 feet above sea level and the maximum is 17 feet. In most places the water table is just 18 inches below the surface. These conditions make it difficult to dispose of sewage economically. The city, with a population of 71,000 and located on an island 2 3/4 miles wide and 29 miles long, has come up with economical solutions for these conditions. As the city's sewer system expands to outlying districts factory-built treatment plants are being installed instead of lift stations to move sewage to a central plant. First cost of these plants is no more than lift stations and they are more economical in the long run. The infiltration problem is being dealt with by using Armco Steel Corporation's Truss Pipe for all new sewer installations. With this pipe an infiltration specification of 100 gal/in/day is being used. Galveston has been using this pipe for two years and has about 10,000 feet in the ground. Design criteria is 80 gal. pcd not counting infiltration. The city has three package plants in operation and plans to match growth by the use of additional package plants and plastic Truss Pipe. (Goessling-Texas)

W72-01855

JACKING A SEWER UNDER AN INTERSTATE HIGHWAY.

Public Works, Vol 101, No 5, May 1970. 3 fig.

Descriptors: *Sewers, *Construction, Casing, Steel pipe, Indiana, Highways.
Identifiers: *Interstate highway, Precise grade, Hydraulic rams, *Speedway (Ind).

Crossing an interstate highway with a 16 in. diameter sewer on a critical grade of 0.22 percent posed a problem for a contractor in Speedway, Indiana. In order to maintain the precise grade and install the pipe under the highway with the least possible interference, the contractor elected to use a 36 inch

outside diameter welded steel casing to carry the pipe. Hydraulic rams developing thrusts of up to 100 tons were used to jack 20 foot sections of casing through the highway fill. A workman inside the casing used an air spade to excavate fill material from the path of the pipe. The casing was laid slightly below grade to allow the sewer pipe to be aligned accurately within the casing. Sewer pipe supports were welded into the outer casing and the 16 in. pipe was wired down to these supports at ten foot intervals to prevent floating in case of floods. (Goessling-Texas)

W72-01856

WASTEWATER TREATMENT AND RE-USE OF TREATED SEWAGE AS AN INDUSTRIAL WATER SUPPLY,

Imperial Smelting Corp. Ltd., Avonmouth (England).

D. Eynon.

The Chemical Engineer, January/February 1970, p 6-7, and p 13. 1 tab.

Descriptors: *Waste water treatment, *Water reuse, Activated sludge, Effluents, Cooling water, Heavy metals, Coagulation, Sedimentation, Lime, Slurry, Water quality, Sewage, Municipal wastes, Industrial water.
Identifiers: Gas scrubbers, Zinc hydroxide.

For a new integrated zinc and lead and lead smelter at Avonmouth, an assured water supply of 4 mgd was required. A portion of the water had to be of high quality and this was obtained from the town water system. A large portion of the water did not have to be of such quality and, after a thorough evaluation of potential sources of supply and the associated costs, sewage effluent meeting the Royal Commission standards was selected as the least cost supply meeting the required water quality standards. Effluents from an activated sludge plant are used for fume scrubbing on a wet process phosphoric acid plant, for direct cooling of furnaces, for cooling and scrubbing hot furnace gasses, for wet gas scrubbers of ventilation gasses and for molten slag quenching. The liquid effluents of several of these processes must be clarified prior to discharge in order to meet the standards established by the River Authority. Coagulation with a lime slurry and zinc hydroxide reduces the suspended solids and precipitates undesirable heavy metals as hydroxides. The effluent of this treatment is discharged to a spray cooling pond where it can be recirculated through the plant or discharged into the Severn River. Calcium salts in the once through water has been a problem, however, blending once through water with new water resolved the difficulties. (Goessling-Texas)

W72-01860

SEWERAGE PRACTICE IN THE GULF COAST AREA,

Tulane Univ., New Orleans, La.

J. K. Mayer, S. E. Steimle, and F. W. MacDonald. Public Works, Vol 101, No 8, August 1970, p 71-72. 1 fig, 2 tab, 2 ref.

Descriptors: *Sewers, *Survey, Sanitary sewers, Length, Materials, Infiltration, Flows, Saturated soils, Water table, Gulf of Mexico.
Identifiers: *Gulf coast area, Combined sewers.

For the purpose of obtaining background information on sanitary sewers in the Gulf Coast area, 71 municipalities and sewer districts spanning the coast from Texas through Florida were canvassed by questionnaires during the latter part of 1967 and the early part of 1968. The questions were designed to establish the following: (1) type of sewers; (2) length of sewers; (3) material of pipe construction; (4) type of bedding used; (5) infiltration experience; (6) soil description and depth of water table; and, (7) average flow and treatment used. There were forty replies for an effective return of 55%, representing 63% of the population in the area. An attempt was made to analyze the data to define correlations, however, the data was so scat-

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

tered that none were possible. The possibility exists that there is in the data, a correlation between percent infiltration and depth of water table. The data collected is discussed and represents initial presentation of sewerage practice in the Gulf Coast area. (Goessling-Texas)
W72-01861

INSECT POPULATIONS OF SLUDGE-DRYING BEDS,

Upper Tame Main Drainage Authority, Birmingham (England).
M. B. Green.

Water Pollution Control, Vol 69, No 3, 1970, p 399-408. 4 fig, 3 tab, 17 ref.

Descriptors: *Sludge, *Insects, *Public health, Sludge digestion, Drying, Dewatering, Larvae, Oviposition, Intermediate hosts, Carriers, Diseases, Sampling. *Waste water treatment.

Traps covering an area of 12 sq in were placed on sludge drying beds to capture emerging insects. A wide variety of variables including sludge moisture content, data of placement of the sludge in the drying beds and organic content of the sludge dry matter, was investigated between July 1967 and December 1968. A total of 3,027 insects were obtained from 335 sampling occasions. More insects were captured during the warmer months, but numbers for most species were insufficient to make definite statements about seasonal incidence. However, a clear pattern was demonstrated in 1968 for the two most numerous species. Very dry sludges were shown to produce far fewer insects than wetter sludges (sludges more recently placed in the beds). Few qualitative differences were distinguished, but scatopods were generally found more often on the drier sludges and sepiads, although never numerous, on the wetter ones. On the two smaller sludge works, 2,236 insects were caught in three trappings. These investigations revealed that the fauna of sludge drying beds resembles that of dung, with the degree of resemblance dependent upon the extent of digestion of the sludge. (Lowry-Texas)
W72-01863

KINETICS OF THE STEADY STATE BACTERIAL CULTURE IV. TRANSFER RATES,

Public Health Service, Washington, D.C.
E. J. Martin and D. R. Washington.

Proceedings, Industrial Waste Conference, 20th, May 4, 5, and 6, 1965, p 470-500. 9 fig, 19 tab, 26 ref.

Descriptors: *Waste water treatment, Carbon dioxide, Laboratory tests, Data collections, Mathematical analysis, Yield equations, *Bacteria, Cultures, *Metabolism.

Identifiers: *Pseudomonas fluorescens, *Carbon transfer rates.

Overall carbon transfer rates and the relationship to the metabolic activity of organisms were studied through the use of pure bacterial cultures in a continuous flow or steady state apparatus and carbon-14 tracer techniques. *Pseudomonas fluorescens* were fed with uniformly labeled glutamic acid carbon-14 as a constituent of the organic substrate. The steady state system was treated as being composed of compartments, i.e., 'carbon pools' described by sets of linear differential equations for mathematical analysis. Oscillations within compartments with respect to feed, cells, organic and inorganic phases of the liquid effluent and gaseous effluent (CO_2) are described by two equations, the rate of change of radioactivity with time and the rate of change of carbon with time. These equations were solved for the constant coefficient-carbon transfer rates between the various compartments in the steady state. The carbon transfer rate of cells to soluble organic substrate was observed to exhibit a maximum at or near Dilution Rate, $D = 0.5/\text{hr}$. A maximum effective yield (γ) was observed at the same value of D . At dilution rates greater and less than that above, the cell-substrate

transfer rate increased and the effective yield coefficient was observed to decrease. The magnitude of the observed variations would seem to be significant in industrial fermentation processes using continuous microbial cultures. (Goessling-Texas)
W72-01865

DISPOSAL OF NITROGENOUS LIQUID EFFLUENT FROM MODDERFONTEIN DYNAMITE FACTORY,

African Explosives and Chemical Industries Ltd., Johannesburg (South Africa).
N. A. Lever.

Proceedings, Industrial Waste Conference, 21st, May 3, 4, and 5, 1966, p 902-925. 1 fig, 8 tab, 13 ref.

Descriptors: *Waste water treatment, *Waste water disposal, Water reuse, Effluents, Economic analysis, Grasses, Irrigation, Sulphur compounds, Nitrogen compounds, Cattle feeds, Laboratory tests, Hydraulic structures, Costs, Liquid wastes.

The Modderfontein Dynamite Factory has been in operation in South Africa since 1896, when the sulphuric acid and nitric acid plants started up. The plant has grown since then and is now a major explosive and chemical manufacturer. With the advent of limitations on the contaminants that could be discharged to local streams, the plant was faced with several choices of how to proceed. A thorough analysis of the alternatives from treatment for reuse through removal of contaminants and discharge to grass plot irrigation was conducted and led to the choice of grass plot irrigation as the most attractive means of effluent disposal. Since the initial decision, 2,600 acres have been placed under irrigation. This acreage grows hay for use on the site or for sale and grass for grazing and fattening cattle purchased for that purpose. Analysis by agronomists indicated the acceptable amounts of nitrogen that could be applied and the additional fertilizers needed for good growth. The results so far have been good. Current costs for disposal are \$0.38/1000 gal. With favorable markets these costs could be as low as \$0.01/1000 gal. and with the sale of the 700 head of cattle being grazed on the land, a small profit might be obtained. This plant is satisfactorily disposing of its liquid effluents and at the same time producing a salable product. (Goessling-Texas)
W72-01866

CHEMISTRY OF NITROGEN AND PHOSPHORUS IN WATER.

American Water Works Association, New York. Water Quality Div. Committee on Nutrients in Water.

For primary bibliographic entry see Field 05C.
W72-01867

EFFECT OF SULFATE AND OTHER IONS IN COAGULATION WITH ALUMINUM,

Nebraska Univ., Lincoln. Dept. of Civil Engineering.
G. P. Hanna, Jr., and A. J. Rubin.

Journal of the American Water Works Association, Vol 62, No 5, May 1970, p 315-321, 8 fig, 30 ref.

Descriptors: *Waste water treatment, *Coagulation, *Aluminum, *Sulfates, Hydrogen ion concentration, Concentration, Stability, Flocculation, Laboratory tests, *E. coli, *Ions.

Identifiers: Clarification, Insoluble aluminum, *Sulfate ions.

Coagulation of *ESCHERICHIA coli* by aluminum sulfate was investigated, and the effects of several diverse ions were examined. The entire log-concentration-pH domain of stability for coagulation by aluminum sulfate was established and compared to a similar domain previously established for coagulation by aluminum nitrate. The coagulation of *E. coli* by aluminum sulfate shows a marked concentration pH dependence similar to that noted for aluminum nitrate. The differences in the two

domains can be related to the basicity of the anions and consequently to the aggregating species formed. The main differences are in the location of the left boundary of the sweep zone, and the lack of a central destabilization zone when using aluminum sulfate. The results indicate that clarification was most rapid and complete in the presence of insoluble aluminum 'floc'. The mechanism of rapid clarification and settling in the sweep zone is attributed to the entrapment of the dispersed phase in precipitating gelatinous aluminum hydroxide. Apparently, the soluble aluminum hydrolysis products play only a minor role in the sweep zone since their coagulating action is relatively slow. (Goessling-Texas)
W72-01869

THE BIOCHEMICAL ASPECTS OF AEROBIC BACTERIAL GROWTH,

Dow Chemical Co., Midland, Mich. Biochemical and Chemical Research Labs.

For primary bibliographic entry see Field 05F.
W72-01870

RADIOACTIVE WASTES-THEIR TREATMENT AND DISPOSAL,

Atomic Energy Research Establishment, Harwell (England).
R. H. Burns.

Proceedings, Industrial Waste Conference, 21st, May 3, 4, and 5, 1966, p 714-743, 17 fig, 7 tab, 9 ref.

Descriptors: *Waste water treatment, *Solid wastes, *Radioactive waste disposal, *Waste disposal, Radioisotopes, Background radiation, Fall out, Tracers, Industrial wastes, Power plants, Chemical precipitation, Vacuum drying, Evaporation, Incineration, Landfills, Foam separation, Electrodialysis, Reverse osmosis, Ion exchange, Solvent extraction, Radioactive wastes.
Identifiers: Electrodeionization.

The treatment and disposal of radioactive wastes is a comparatively new technology and, in addition, presents certain features which are not necessarily encountered with other waste products. After a review of present controls permissible discharge concentrations, treatment methods and disposal methods it can be concluded that current methods for the treatment and disposal of radioactive wastes are demonstrably adequate and very safe. It is clear that further development of the Atomic Energy Industry will not be hindered by waste disposal problems. Nevertheless, considerable work is being carried out and much manpower expended in an attempt to develop even better and more economical methods. Foam separation, reverse osmosis, electrodialysis and electrodeionization are examples of liquid treatment processes which show promise. The separation of individual radionuclides from mixed fission products and putting these to use as valuable solid sources has always been an attractive possibility. To date this has not been able to compete economically with other methods of producing sources, but the advances in chemical treatment methods, solvent extraction and the use of natural and synthetic ion exchanges with high ionic selectivity may well change in picture. Radioactive residues have been and are being well handled. This same excellence should continue into the future. (Goessling-Texas)
W72-01871

CHEMICAL ASPECTS OF SOME WASTE DISPOSAL PROBLEMS,

Imperial Chemical Industries Ltd., London (England).
L. W. Oldham.

Water Pollution Control, Vol 70, No. 4, 1971, p 419-423.

Descriptors: *Chemical wastes, *Waste water treatment, *Water quality control, Odors, Air pollution, Toxicity, Neutralization, Chemical precipitation, Oxidation, Electrolysis, Chlorination.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Waste Treatment Processes—Group 5D

tion, Industrial wastes, Separation techniques, Waste disposal, Sludge disposal.
Identifiers: *Chemical treatment.

A review of the chemicals and processes used for neutralization, removal of toxic metals, prevention of obnoxious odors, air oxidation and sulphides, removal of cyanides, destruction of p-chlorophenol, and destruction of waste volatile sulfur compounds was conducted. In each instance, the individual characteristics of the particular problem were examined, indicating that no universal solutions exist. Problems presented relate both to water and air pollution, dealing mainly with operational and nuisance problems. In some cases the particular effluent may be susceptible to physical forms of treatment also, such as electrolysis or biological treatment. In the final analysis, sludge production is the usual criteria which determines the economics of a particular method since sludge disposal is usually a major portion of the cost of a sludge-producing method. (Lowry-Texas)
W72-01872

A STUDY OF PINEAPPLE CANNERY WASTE,
Washington Univ., St. Louis, Mo. Dept. of Civil and Sanitary Engineering.

N. C. Burbank, Jr., and J. S. Kumagai.

Proceedings, Industrial Waste Conference, 20th May 4, 5, and 6, 1965, p 365-397, 24 fig, 9 tab, 15 ref.

Descriptors: *Waste water treatment, Industrial waste, Canneries, Survey, Flows, Chemical oxygen demand, Biochemical oxygen demand, Activated sludge, Nitrogen, Phosphorus, Hydrogen ion concentration, Laboratory tests, Data collection, Ion exchange, Toxicity, Efficiencies, Industrial wastes, Hawaii.

Identifiers: Pineapple processing, Sugar removal.

The waste flows and waste characteristics of a major pineapple cannery located in Hawaii have been studied with the view of determining the suitability of the activated sludge process for treatment. The measurement program covered a period of 6 days during the peak of the canning season. The average total flow was 3.0 MGD with variations from 2.74 to 3.20 MGD. The COD of the wastewater ranged from 24.1 to 32.8 lbs/ton of pineapple processed with the average being 26.2 lbs/ton. The pH of the waste varied from 3.4 to 11.2, however, equalization over a short period provided a wastewater consistently in the neutral pH range. Sugar removal was found to be a convenient indicator of treatment efficiency. A continuous feed activated sludge process removed over 90% of the sugar with a biomass consisting primarily of gram negative rods. In batch systems, fungi and yeasts contributed to the continuing high removals. Laboratory determinations indicated that the wastes were not toxic, the wastes were biodegradable, adequate nitrogen and phosphorus were present in the wastes to support biomass growth, and the primary constituent of the COD was sugar. High sugar removals can be expected at loading rates up to 17.5 pounds of sugar per pound of MLSS per day. (Goessling-Texas)
W72-01876

MEASUREMENT, CONTROL AND CHANGES IN FOAMING CHARACTERISTICS OF PULPING WASTES DURING BIOLOGICAL TREATMENT,
National Council for Stream Improvement, Baltimore, Md.

W. L. Carpenter, and I. Gellman.

Proceedings, Industrial Waste Conference, 21st, May 3, 4, and 5, 1966, p 203-213, 6 fig, 1 tab, 20 ref.

Descriptors: *Waste water treatment, *Pulp wastes, *Biological treatment, *Activated sludge, *Industrial wastes, *Foaming, Pulp and paper industry, Measurement control, Laboratory tests, Data collections.

Foaming problems are frequently encountered during discharge and biological treatment of pulp and paper mill effluents. In contrast to the prevalence of these problems, the lack of adequate methods for characterizing foaming and of experimental data on the control of, or changes in, foaming during biological treatment led to an experimental study. This study made possible the development of a method found to be useful in (a) characterizing foaming of kraft effluent, (b) measuring the changes in the foamingness resulting from biological treatment, (c) changes in lignin content, and (d) addition of foam control formulations. The method is simple to apply and is readily applicable to studies of factors controlling foaming of pulping wastes. Indications are that Foam Stability is probably accounted for by readily degradable material while Foaming Tendency is more closely related to biological stable materials, lignin. Degradation products of lignin were observed to be non-foam producing and where lignin color was removed from wastewater, foam production was decreased. Silicone formulations were noted for their ability to control kraft effluent foam. Studies are continuing to gain further insights into the problem. (Goessling-Texas)
W72-01877

EFFECT OF FILTER CLOTH STRUCTURE ON FLOW RESISTANCE, BLEEDING, BLINDING AND PLANT PERFORMANCE,
University of Manchester Inst. of Science and Technology (England).

A. Rushton.

The Chemical Engineer, April, 1970, p 88-94, 5 fig, 19 ref.

Descriptors: *Waste water treatment, *Filtration, *Pulpwastes, Suspended load, Concentration, Diffusion, Particle size, Particle shape, Separation techniques, Fibers (Plant), Textiles.

Identifiers: *Cloth blinding, Bleeding, Wear, Fiber dissolution.

Little quantitative information exists which would facilitate the choice of the most suitable filter medium for the separation of a particular suspension. The suitability of the medium will be decided by its behavior in the filter; a successful separation of the suspended solids from the fluid must be obtained along with the absence of bleeding or blinding by the particles of the cloth. Other factors must be considered, of course, including rate of wear, dissolution of fibres by the fluid, etc. The experimental investigation reported here is concerned principally with filtration capacity and quality of filtration when solids are separated from liquids. Although some of the work may be applied to gaseous suspensions, it is reasonable to report that while detailed analysis of cloth structural effects on flow is of great importance in understanding the filtration pattern, great care must be exercised in use of the data for the prediction of the cloth in machines. The stresses set up in the machine may cause considerable change in the character of the cloth. The overall performance of the machine may be determined by small concentration changes in the feed slurry and this effect can be of greater importance than the resistance of the medium, except where the latter is the result of complete blinding. (Goessling-Texas)
W72-01878

ADVANCE WASTEWATER TREATMENT,

Dorr-Oliver, Inc., Stamford, Conn.

C. W. Smith, and D. DiGregorio.

Chemical Engineering, Deskbook Issue, April 27, 1970, p 71-74, 3 fig, 1 tab, 4 ref.

Descriptors: Water quality, *Waste water treatment, *Tertiary treatment, Suspended load, Diatomaceous earth, Chemical precipitation, Membrane processes, Activated carbon, Distillation, Electrodialysis, Ion exchange, Reverse osmosis.

Identifiers: Soluble organics, Microscreens.

Conservationists estimate that by 1980, daily consumption of water by U.S. industry, agriculture and municipalities, will exceed our fresh water resources of 600 billion gal/day. The two most important conservation methods probably will be more efficient use of water by industry and application of advanced wastewater treatment methods. In addition to reuse, advanced treatment techniques will be required to maintain water quality in the face of escalating urbanization and population. Tertiary treatment can remove suspended solids that account for 35 to 80% of the organic pollutants. Current processes for solids removal include diatomaceous earth filtration, chemical clarification, microscreening and membrane systems. As water renovation and reuse becomes more prevalent, it will be increasingly important to remove soluble organic materials which can exert an oxygen demand on the receiving water. Activated carbon adsorption systems are the primary current system for such removals. As in the case of soluble organics, eventually water renovation will have to include demineralization. Distillation, electrodialysis, ion exchange, and reverse osmosis are among the processes studied so far. Waste water renovation not only decreases the demands on our streams, but enables us to improve water quality in the face of increasing urbanization. (Goessling-Texas)
W72-01879

AEROBIC DECOMPOSITION OF ALGAE,

Stanford Univ., Calif.

William J. Jewell, and Perry L. McCarty.
Environmental Science and Technology, Vol 5, No. 10, October 1971, p 1023-1031, 7 fig, 4 tab, 40 ref.

Descriptors: *Oxygen requirements, *Decomposing organic matter, Aeration, *Algae, *Biodegradation, Laboratory tests, Filtration, Ammonia, Hydrogen ion concentration, Temperature, Light intensity, Sedimentation, Oxidation, Storage, Biochemical oxygen demand, Chemical oxygen demand, Phosphorus, Nitrogen, Eutrophication, *Aerobic conditions, *Aerobic treatment.
Identifiers: Refractory materials.

5 GAL. WATER SAMPLES FROM VARIOUS LAKE, STREAMS, AND RESERVOIRS, AS WELL AS EFFLUENTS FROM SEVERAL SEWAGE TREATMENT FACILITIES WERE OBTAINED. Each sample was filtered and aerated, to allow oxidation of all reduced materials, exposed to diurnal fluorescent light, and aerated with a mixture of 1% CO₂ in air. Lighting, pH and temperature were held constant during any given experiment. At predetermined time intervals, samples were taken from the illuminated vessels and placed in dark vessels and aerated with the same aeration mixture. Results of these tests indicated that algae and algal-derived organic matter consisted of three fractions. The first fraction consisted of degradable storage products that disappear within a few hours after the organisms are placed in the dark. Oxygen demand of the storage products was deemed insignificant in long-term considerations, but its decomposition was determined to be a possible significant factor in influencing diurnal oxygen variations in natural waters. Biodegradable organic material, the second fraction, comprised some 30% of the total mass of organic algal materials. A fairly constant, but intermediate, first order rate constant (.01 to .06 day⁻¹) was determined, indicating that all of the biodegradable organics should be decomposed within one year. The remaining fraction, refractory material was found to decompose by only a few percent per year, having a significant oxygen demand only by accumulation. (Lowry-Texas)
W72-01881

VIABILITY OF LONG-STORAGED AIRBORNE BACTERIAL AEROSOLS,
Illinois Univ., Urbana. Dept. of Civil and Mechanical Engineering.

Calvin C. Poon.

Journal, Sanitary Engineering Division, Proceedings, ASCE, Vol 96, No. SA 6, December 1968, p 1137-1146, 5 fig, 1 tab, 8 ref.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Descriptors: *Aerosols, *Bacteria, *Public health, Activated sludge, Evaporation, Laboratory tests, Pressure, Temperature, Humidity, Tracers, Flow rates, Sampling, *Waste water treatment, *G coli. Identifiers: Death rate constants.

A pure culture of *E. coli* was grown in synthetic growth medium and tagged with radioactive μ 32 as a tracer. Bacterial aerosols were sprayed into the air by an atomizer and recirculated by a Dynapump back into the main storage chamber. Hourly samples were taken for 4 hour total storage time at a rate of 21 per minute. Death rate constants were calculated for the first two hours and the last two hours separately, and the death rate constant for the first two hours was consistently greater. RH and temperature were both held constant for these tests. Studies were also conducted to determine the evaporation rates of various liquids and the effects of different chemicals on the evaporation rate. It was determined that: (1) increase of air temperature will increase the death of airborne cells; (2) a decrease in relative humidity will increase the bacterial aerosol death rate; (3) the rate of water evaporation still plays an important role in the viability of airborne cells as is found in the case of instantaneous death of bacterial aerosols; (4) the viability of airborne bacteria is affected by the presence of chemical additives due to their effects upon water evaporation; (5) bacterial aerosols from sewage treatment plants can survive a long time due to the presence of chemical additives. Because of these factors, bacteria aerosols should be considered as a potential hazard to public health. (Lowry-Texas)
W72-01882

BIOLOGICAL TREATMENT OF STRONG INDUSTRIAL WASTE FROM A FIBERBOARD FACTORY, Union Allumette, Overboelar (Belgium).

Proceedings, Industrial Waste Conference, 22nd, May 2, 3, and 4, 1967. p 884-891, 1 fig.

Descriptors: *Waste water treatment, *Industrial wastes, *Effluents, Water quality, Activated sludge, Trickling filters, Biochemical oxygen demand, Low flow, Suspended load, Survey, On-site data collections, *Biological treatment, *Pulp wastes.

Identifiers: Fiberboard plant, Dender River (Belgium).

A fiberboard factory is located on the river Dender into which wastewaters are discharged. In the manufacture of fiberboard, the 'wet' process is used and the resulting wastewaters can be very strong, BOD of 2,000 to 2,500 mg/l. In 1955, our company undertook a research program to determine the most effective waste treatment process. In view of our study and the equipment available, the choice narrowed to trickling filters or activated sludge. The limited space and the availability of some unused tanks led us to select activated sludge as the waste treatment process. After many trials and problems, the system developed into full operation and is providing a satisfactory effluent. Due to the variation in flows of the river Dender and the laws controlling discharges, we operate the wastewater treatment plant only during the periods of low flows (March to November). The company samples the water quality as far downstream as 20km. on a weekly basis. So far this treatment philosophy is having a good effect, no offensive conditions and the fish are returning to the river. Total investment costs are \$140,000 and operating costs have decreased from \$0.13 per kg BOD removed in 1961 to \$0.071 per kg in 1966. (Goessling-Texas)
W72-01885

VIRUS REMOVAL BY COAGULATION WITH POLYELECTROLYTES, Maine Univ., Orono. Dept. of Civil Engineering. For primary bibliographic entry see Field 05F. W72-01886

RECLAIMED WASTE WATER FOR GROUND-WATER RECHARGE, California State Water Resources Control Board, Sacramento.

D. C. Baier, and G. M. Wesner. Water Resources Bulletin, Vol 7, No 5, p 991-1001, October 1971. 2 fig, 6 tab, 5 ref.

Descriptors: *Water reuse, *Groundwater recharge, *Tertiary treatment, *Reclaimed water, *California, Water quality, Odor, Taste, Artificial recharge, Injection wells. Identifiers: Trickling filters.

Reclaimed trickling filter effluent is injectable and does not cause excessive well clogging. Multi-casing injection wells performed very satisfactorily. The reclaimed water would be acceptable for domestic use after travel through 500 feet of a confined aquifer in that bacteria, virus and toxic material were consistently absent, but the odor, taste, and high concentrations of dissolved inorganics are undesirable characteristics. Methods to eliminate the odor are being tested. (Knapp-USGS)
W72-02006

GAS-PHASE CATALYTIC OXIDATION OF PHENOL IN DILUTE CONCENTRATIONS WITH WATER VAPOR,

Delaware Univ., Newark. Dept. of Chemical Engineering.

M. A. Walsh. Research Report, May, 1970. 65 p, 5 fig, 5 tab, 19 ref, 5 append. OWRR A-014-DEL (1).

Descriptors: *Water pollution sources, *Water pollution treatment, *Water vapor, *Phenols, *Oxidation, Catalysts, Copper, Aluminum, Gases, Chemical reactions, Carbon dioxide, Analytical techniques, Diffusion, Water chemistry.

The gas-phase catalytic oxidation of phenol with air in dilute concentrations with water vapor was studied in a temperature range of from 150 to 270 degrees C. The reaction over a CuO on alumina catalyst followed first order kinetics in the range of reactant conversion (0 to 0.75) examined. The average value of the order of reaction with respect to phenol was 1.084. The oxidation was complete to carbon dioxide and water with no intermediate reaction products noted. The energy of activation for this reaction was about 7.22 kcal/g-mole-degrees K. The results of this work were found to be highly reproducible. No decrease in catalyst activity was observed over a four-month period of experimentation. No diffusional limitations were present in the transport of reaction species to and from the catalyst sites. (Woodard-USGS)
W72-02050

FEASIBILITY OF RECHARGING TREATED SEWAGE EFFLUENT INTO A DEEP SANDSTONE AQUIFER,

Illinois State Water Survey, Urbana.

R. J. Schicht.

Proceedings of the National Ground Water Quality Symposium, Denver, Colorado, August 29-31, 1971: Ground Water Vol 9, No 6, p 29-34, November-December 1971. 5 fig, 1 tab, 10 ref.

Descriptors: *Artificial recharge, *Injection wells, *Reclaimed water, *Water reuse, *Illinois, Tertiary treatment, Aquifers, Aquifer characteristics, Water management (Applied), Permeability, Sandstones.

Artificial recharge with tertiary treated sewage effluent is suggested as one remedial measure for projected groundwater deficits in the Chicago region. A deep sandstone aquifer, and improvement source of groundwater in the region, offers the best opportunity for artificial recharge. Recharge will be through wells because the aquifer is deeply buried. Expected problems in maintaining well injection capacity were studied by recharging treated effluent through formation cores of the sandstone. Recharge rates were maintained at constant heads for several days. (Knapp-USGS)
W72-02077

COLOID FLOTATION AND ADSORBING COLOID FLOTATION,

Northeastern Univ., Boston, Mass. Dept. of Chemistry.

Barry L. Karger.

Copy available from NTIS as PB-205 001, paper copy \$3.00; microfiche \$0.95. Final Technical Report, December 1970. 79 p, 30 fig, 69 ref. EPA 17010DBL.

Descriptors: *Waste water treatment, *Flootation, *Ion exchange, *Separation techniques, *Water purification, *Surfactants, Montmorillonite, Phosphates, Colloids, Cation adsorption, Kaolinite, Manganese, Surface tension. Identifiers: Manganese dioxide.

Different separation processes are discussed that have potential application in the wastewater treatment field: (1) colloid flotation (2) coagulation of finely divided ion exchange resin for rapid ion removal, and (3) adsorbing colloid flotation. For each method, the implications to waste water treatment are detailed, and potential applications are explored. Colloid flotation can be successfully employed in the removal of clays (kaolin and montmorillonite) from waste water streams. There is a close interrelationship between gas bubble diameter and the size of the particle being removed. Gas bubbles of 1-2 mm require fully dispersed colloidal materials, whereas fine bubbles of 0.2 mm required coagulated sols for best removal. An understanding of the mechanism of flotation removal can be obtained through measurement of the zeta potentials of the colloidal particles. Rapid and total ion removal is potentially possible with the use of coagulated mixed ion exchange resins. One way in which this might be accomplished is in a fluidized bed. A total of 10 ppm Cr³⁺ can be rapidly removed from aqueous media by adsorption on hydrous manganese dioxide and the subsequent flotation of the colloid. The manganese dioxide can be generated in situ by the standard oxygenation reaction.
W72-02105

PROBLEMS OF INDUSTRIAL RESIDUAL WATERS IN THE HOOGHLY ESTUARY ZONE (INDIA), CONCRETELY THE ONES FROM PAPER PULP AND HYDROGENATED VEGETABLE OIL INDUSTRIES (PROBLEMES D'EAUX RESIDUAIRES INDUSTRIELLES DANS LA ZONE DU HOOGHLY ESTUARY (INDE), NOTAMENT DES FABRIQUES DE PATE A PAPIER ET D'HUILE VEGETALE HYDROGENEE),

Institut Central de Recherches sur les Peches Internationales, Barrackpore (India).

For primary bibliographic entry see Field 05B.
W72-02208

RENOVATING SEWAGE EFFLUENT BY GROUND-WATER RECHARGE,

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

H. Bouwer, J. C. Lance, and R. C. Rice.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 225-244, 1971. 3 fig, 1 tab, 14 ref.

Descriptors: *Sewage effluents, *Waste water treatment, *Groundwater recharge, *Infiltration, *Tertiary treatment, Arizona, Arid lands, Pilot plants, Water chemistry, Water purification, Water quality control, Irrigation water, Municipal wastes, Economic feasibility, Observation wells. Identifiers: *Salt River Valley, *Recharge basins.

Sewage effluent is commonly used for the irrigation of crops that are not consumed raw. Due to continued population growth in the Salt River Valley, Arizona, economic reuse of municipal waste waters is becoming essential. The Salt River bed has about 3 ft of fine loamy sand underlain by sand and gravel layers to great depth and a groundwater table at

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Ultimate Disposal of Wastes—Group 5E

about 10 ft depth. These conditions are very favorable for high-rate waste water reclamation by groundwater recharge. The activated sludge plant in Phoenix will probably be discharging 250 mgd by the year 2000. At 4.5 ft average annual water use, this could irrigate about 70,000 acres, possibly more than agriculture will need at that time. A sewage effluent renovation pilot project was located about 1.5 miles from the plant. It contains 6 parallel recharge basins 20 to 700 ft each, spaced 20 ft apart. The basins were covered by grass, gravel or were left bare. Observation wells were installed at various locations in the area. Results indicated that infiltration rates were fastest in the grassy basins. Phosphate, Nitrogen and median fecal coliform levels were all lower after this form of tertiary treatment. Practical details of the application of this water reclamation method in the Salt River Valley are outlined. Costs would be 5 dollars/af, less than 1/10 the equivalent costs of in-plant tertiary treatments. (Casey-Arizona)

W72-02226

5E. Ultimate Disposal of Wastes

MODEL STUDIES OF OUTFALL SYSTEMS FOR DESALINATION PLANTS (PART I - FLUME STUDY),

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

F. M. Holly, Jr., and J. L. Grace, Jr.

For sale by Supt. of Documents U.S. Govt. Printing Office, Washington, D.C. 20402 - Price \$0.65. Office of Saline Water Research and Development Progress Report No. 714, August 1971. 57 p, 17 fig, 3 tab, 22 ref. Contract 14-30-2656.

Descriptors: *Brine disposal, *Outlets, *Saline water, *Water pollution effects, Effluents, Desalination, Discharge (Water), Waste water disposal, *Model studies, Diffusion, Flumes. Identifiers: *Ecology, *Effluents.

Flume studies were conducted to evaluate the degree of mixing attainable through the use of a diffuser located on the estuary or ocean floor beyond the surf zone. The dense brine is discharged vertically through circular ports into a uniform and steady crosscurrent. The prototype conditions which were modeled or simulated were (a) 0.1 to 1.0 knot ambient velocity, (b) 8 to 20 fps port discharge velocities, (c) density difference between brine and ambient fluid of 0.0045 to 0.26 g/cc, and (d) port diameters of 3, 6 and 9 inches. Tests were conducted in a 1:20-scale uniform flow flume to evaluate the effects of port diameter, brine flow rate, density differential and ambient velocity on the geometry and mixing characteristics of a dense jet discharged vertically through a single port. Tests using a multiple-port diffuser verified that linear superposition of single-port results can be used to predict multiple-port mixing characteristics. A multiple-port diffuser has a significant advantage over a simple outfall pipe in keeping high concentrations of dissolved ions away from the ocean floor. (OSW abstract)

W72-01838

THE DE-WATERING OF DIGESTED SLUDGE USING SYNTHETIC FILTERING AGENTS,

Stuttgart Univ. (West Germany).

O. Tabasaran.

Water Research, Pergamon Press, 1971, Vol 5, p 61-70. 11 fig, 8 ref.

Descriptors: *Sludge disposal, *Dewatering, *Filtration, Flocculation, Mixing, Compressibility, Laboratory tests, Data collection, *Waste disposal, Coagulation. Identifiers: *Polymer filtering agents, Specific resistance, Dilution.

Now that wastewaters can be treated economically, the problem that remains is that of disposal of the resulting sludge. This laboratory conducted a number of experiments to determine the effective-

ness of polymers in enhancing the de-watering characteristics of digested sewage sludge. The use of the cationic 'Sedipur-KA' greatly accelerated separation of water from the solids. The most effective coagulation, with less than optimum dosages, resulted only after a sufficient mixing time. When the optimum amount of polymer was used, the effect of mixing time was insignificant. The quantity of filtering agent used has a considerable influence on speed of filtration, specific resistance and sludge compressibility. There is an optimum dosage of polymer which is specific to the type of sludge which provides the best flocculation and hence the most rapid dewatering. Dilution of the sludge prior to polymer addition reduced the solids content and reduced the effectiveness of the dewatering process. The organic content of the filtrate was fairly high and increased as the amount of polymer filtering agent was increased. Therefore, the filtrate must be treated before discharge into the receiving water. (Goessling-Texas)

W72-01846

THEORETICAL EVALUATION OF FILTER MODELING EXPERIMENTS,

Clarkson Coll. of Technology, Potsdam, N.Y.

Dept. of Civil Engineering.

Charles R. Ott, and Richard H. Bogan.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA 2, April 1970, p 455-465. 1 fig, 2 tab, 11 ref.

Descriptors: *Filtration, *Waste water treatment, *Mathematical models, Deposition (Sediments), Porosity, Particle size, Separation techniques, Flow rate, Turbidity, Analytical techniques.

Identifiers: *Suspended solids.

Although rapid sand filtration is widely practiced, the actual fundamental processes involved have escaped definition. A better understanding, and a quantitative application of the basic mechanisms, principles, and functional characteristics of the filtration process, has been the goal of many investigations. As a result, mathematical models have been formulated, purportedly describing the process of filtration with respect to Lambda, the impedance modulus, Sigma, the specific deposit, and C, the concentration of suspended particles at depth L. Evaluations of Lambda, Sigma, and C by current practices were found to be subject to severe limitations. Theoretical calculations of particulate volumetric concentration presently form the basis for evaluations of Lambda and Sigma. Direct measurements, obtained from presently available particle size counting devices, seem to present significant advantages over present approximation techniques. An equation was formulated for the calculation of Lambda, since present methods are subject to considerable errors. Initial bed porosity, a significant factor of influence of Lambda, was found amenable to step changes to avoid the difficulties of establishing a series of exact replicate filters or returning a single filter to its original state. (Lowry-Texas)

W72-01859

COAGULATION OF ACTIVATED CARBON SUSPENSIONS,

Northwestern Univ., Evanston, Ill.

Raymond D. Letterman, Robert S. Gemmell, and J. E. Quon.

Journal of the American Water Works Association, Vol 62, No 10, Oct 1970, p 652-658. 9 fig, 3 tab, 8 ref.

Descriptors: *Coagulation, *Separation techniques, *Activated carbon, Flocculation, Mixing, Turbulence, Turbidity, Alkalinity, Hydrogen ion concentration, Adsorption, *Waste water treatment.

Identifiers: *Alum.

Batch, laboratory scale tests were conducted to determine the effects of powdered activated carbon on the alum coagulation turbidity removal process. The study was limited to carbon and

kaolin suspensions. Residual turbidities were measured for different combinations of alum dose, initial concentrations of carbon and kaolin, and alkalinity. pH for each series of observations was held at some constant value. At pH 7.0 and alkalinity of 2 mg/l for carbon suspension, the alum dose associated with the first zone of coagulation was not particularly sensitive to initial carbon concentration. However, minimum residual turbidity was found to increase with increasing initial carbon concentration. Alum dosage required to produce a residual turbidity of one unit varied from 5.8 mg/l for 5 mg/l carbon suspensions to 12.2 mg/l for 500 mg/l carbon suspensions. Alum required to reach the first coagulation zone in a 50 mg/l carbon suspension with initial alkalinity of 2 mg/l increased with increasing pH, with optimum pH dependent on the alkalinity. In kaolin suspensions, alum dosage for suspensions without carbon was slightly higher than the dosage required for suspensions with carbon. (Lowry-Texas)

W72-01862

RADIOACTIVE WASTES-THEIR TREATMENT AND DISPOSAL,

Atomic Energy Research Establishment, Harwell (England).

For primary bibliographic entry see Field 05D.

W72-01871

SUBSURFACE DISPOSAL OF LIQUID INDUSTRIAL WASTES IN ALABAMA-A CURRENT STATUS REPORT,

Alabama Geological Survey, University.

W. E. Tucker.

Proceedings of the National Ground Water Quality Symposium, Denver, Colorado, August 25-27, 1971: Ground Water, Vol 9, No 6, p 10-16, November-December 1971. 6 fig, 14 ref.

Descriptors: *Waste water disposal, *Waste disposal, *Injection wells, *Alabama, *Hydrogeology, Aquifer characteristics, Aquifers, Water pollution control.

Identifiers: *Waste disposal wells.

Four subsurface disposal wells have been drilled and completed in Alabama. It is a policy in Alabama that subsurface disposal is permissible for some wastes if the well is properly designed and completed in an appropriate geologic environment and if conventional methods of waste treatment have been evaluated and proved to be inadequate. The Stauffer well, operating at 75 gallons per minute and 500 psi, is the only subsurface disposal system, other than oilfield brine disposal wells, that is currently in operation. A general discussion of the geology, drilling, completion, and testing techniques is presented for the geologic provinces involved in disposal well operations in Alabama. (Knapp-USGS)

W72-02075

SUBSURFACE STORAGE AND DISPOSAL IN ILLINOIS,

Illinois State Water Survey, Urbana. Hydrology Section.

H. F. Smith.

Proceedings of the National Ground Water Quality Symposium, Denver, Colorado, August 25-27, 1971: Ground Water, Vol 9, No 6, p 20-27, November-December 1971. 3 dig, 11 ref.

Descriptors: *Injection wells, *Waste water disposal, *Underground storage, *Illinois, Water pollution control, Aquifers, Aquifer characteristics, Brines, Industrial wastes, Regulation, Legislation.

Identifiers: *Underground gas storage, *Waste disposal wells.

Both liquids and gases are stored in underground strata in Illinois. The problem of disposal of fluid industrial wastes has caused greatest concern, especially for the possible effects of groundwater quality. Necessary precautions have been established in

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5E—Ultimate Disposal of Wastes

the requirements of the Illinois Environmental Protection Agency (IEPA) which has authority to control, prevent, and abate pollution of streams, lakes, ponds, and other surface and underground waters in the State. Sandstone, limestone, and dolomite are most commonly considered as disposal reservoirs in Illinois. From well cores of such formations, laboratory studies defining the rate of fluid movement, porosity, and permeability and the pressure distribution within the aquifer. There are 24 underground gas storage projects. Gas injection pressures of approximately 0.55 psi per foot are often used. Secondary recovery by water flooding accounted for 73.4 percent of the total oil production in Illinois during 1968. In that year there were 880 active projects in Illinois with 13,107 water injection wells that injected 2581 million gallons of water. (Knapp-USGS)
W72-02076

AGRICULTURAL UTILIZATION OF SEWAGE EFFLUENT AND SLUDGE, AN ANNOTATED BIBLIOGRAPHY,
Robert S. Kerr Water Research Center, Ada, Okla.
For primary bibliographic entry see Field 05G.
W72-02104

DISPOSAL OF REFUSE OR DEAD ANIMALS.
For primary bibliographic entry see Field 06E.
W72-02123

THE DISPOSAL OF AGRICULTURAL WASTE,
D. Gowan.
Effluent and Water Treatment Journal, p 368-372, July, 1971. 1 tab, 3 ref.

Descriptors: *Sewage treatment, *Sewage disposal, *Farms, *Farm wastes, Costs, Cost allocation, Benefits, Economics.

Many local British authorities prefer the 'headage' system of assessing charges for the removal of farm wastes. By this method an arbitrary charge is applied to each type of animal. Local authorities enjoy two advantages from the 'headage' system: (1) the charge may persuade farmers to disconnect from the public sewer, or at least not contemplate a new connection, and (2) the charge is exceptionally easy to calculate and administer. Due to a lack of adequate technical information, this approach has in the past produced highly inequitable results. However, since 1966, the National Farmers' Union, through the production of improved technical information, has helped reduce local authority charges, thereby placing them on a more equitable basis. Most authorities use a modified Mogden formula which is inaccurate with respect to the variable strength of most farm sewages. Since charges should be related to the cost of reception and treatment of the waste at the sewage plant involved, greater equity could be achieved if most treatment took place on the farm. The processes available for on-farm sewage treatment include activated sludge-extended aeration plants, high rate filters, and digesters. (Settle-Wisconsin)
W72-02142

5F. Water Treatment and Quality Alteration

EVALUATION OF EFFECT OF IMPOUNDMENT ON WATER QUALITY IN CHENEE RESERVOIR,
Colorado State Univ., Fort Collins.
J. C. Ward, and S. Karaki.
Research Report No 25, Sept 1969. 67 p, 38 fig, 19 tab, 23 ref.

Descriptors: Effects, *Impounded waters, *Water quality, *Dissolved solids, Dissolved oxygen, Evaporation control, Water budget, Water chemistry, Water temperature, Heat budget, Turbidity, *Reservoir evaporation, Salinity, Algae, Stratification, Salt balance, Bibliographies.

Identifiers: USBR Research Contracts, Cheney Dam, Kans.

A study was conducted to determine the effect of impoundment on the quality of water in Cheney Reservoir near Wichita, Kans. The results showed that an increase in the dissolved solids concentration was directly related to evaporation. On an annual basis, 42% of the total inflow was evaporated from the reservoir. Evaporation control was suggested for controlling dissolved solids concentration; however, this would cause a possibly undesirable increase in reservoir temperature of 12 to 19 deg F. The biological activity within the reservoir did not seem to affect the water quality materially, although some odors were detected. The odor appears to have stabilized at a threshold number of about 5. The effect of the interaction between micro-organisms and nutrients was characterized in the analysis of phosphates, nitrates, and silica concentrations in the reservoir. The dissolved oxygen saturation decreased from 100% at the water surface to 82% at 25 ft depth. No reservoir stratification was detected during the period of data collection. (USBR)
W72-01773

PRE-TREATMENT BASIN FOR ALGAE REMOVAL,

Menasha Electric and Water Utilities, Wis.

Andrew J. Marx.

In: Biology of water pollution, p 239-244. Compiled by W. M. Ingram, L. E. Keup, and K. M. Mackenthun, Federal Water Pollution Control Administration, Washington, D. C., 1967. 1 fig, 2 photos.

Descriptors: *Water purification, *Algal control, *Water supply, *Basins, Water pollution treatment, Copper sulfate, Odor, Coliforms, Economics.

Identifiers: Lake Winnebago (Wis), Menasha (Wis).

Following trials with a small pilot plant, the Electric and Water Utility Company of Menasha, Wisconsin constructed a 600 x 700 ft pretreatment basin at the mouth of Fox River. This basin permitted algae control by a solution of copper sulfate, prepared by dissolving 500 lbs of copper sulfate and 1 qt of sulfuric acid in 1,000 gallons of water in a wooden tank. The tank is connected to a small liquid feeder with a metering device to deliver 2 ppm of copper sulfate. This water pretreatment eradicated algae and weeds, decreased the turbidity, reduced odor and coliform organisms, reduced the expense on chemicals, eliminated the anchor ice, and greatly simplified the management. In 1951 the age of the installation was 5 years. (See also W72-01786) (Wilde-Wisconsin)
W72-01814

MINIMUM DESIGN STANDARDS FOR COMMUNITY WATER SUPPLY SYSTEMS (EXISTING STANDARD-FHA 4517.1) (DRAFT ENVIRONMENTAL STATEMENT).

Department of Housing and Urban Development, Washington, D.C. Assistant Secretary for Housing Production and Mortgage Credit.

Available from the National Technical Information Service as PB-200 393D, \$3.00 in paper copy, \$0.95 in microfiche. June 29, 1971. 74 p, 2 tab.

Descriptors: *Water supply, *Design standards, *Community development, *Environmental effects, *Water distribution (Applied), Water quality control, Water treatment, Construction materials, Pumping, Water storage, Specifications, Environmental engineering.

Identifiers: *Minimum design standards, *Community water supply systems.

The purpose of the draft environmental statement is to solicit constructive and practical alternatives to the existing formulation of the HUD standards for community water supply systems. The principal

impacts of the standard are: (1) It assures water supply facilities which will deliver a satisfactory and continuous supply of safe potable water to housing developments and subdivisions; (2) It provides for meeting recognized standards of quality for chemical, physical and bacteriological content of water; and (3) It protects the user from water that is excessively hard or corrosive. The standards, per se, do not present any adverse environmental effects. (Poertner)
W72-01822

INVENTORY AND PROBLEM DELINEATION, PHASE I REPORT, REGIONAL WATER SUPPLY AND WASTEWATER DISPOSAL STUDY.

Camp, Dresser and McKee, Inc., Boston, Mass.

For primary bibliographic entry see Field 06D.

W72-01830

IMPROVING MUNICIPAL WATER SUPPLIES IN COLORADO BY DESALTING,

URS Research Co., San Mateo, Calif; and White (Ken R.) Co., Denver, Colo.

For primary bibliographic entry see Field 03A.

W72-01839

VIRUS INACTIVATION DURING PHOSPHATE PRECIPITATION,

Dept. of Health, Education and Welfare, Cincinnati, Ohio. Bureau of Solid Waste Management.

For primary bibliographic entry see Field 05D.

W72-01852

SENSORY EXAMINATION OF MINERALIZED, CHLORINATED WATERS,

California Univ., Davis. Dept. of Food Science and Technology.

R. M. Pangborn, R. E. Baldwin, and I. M. Trabue. Journal of the American Water Works Association, Vol 62, No 8, September 1970, p 572-576, 6 fig, 1 tab, 7 ref.

Descriptors: *Water purification, *Chlorine, *Mineral waters, *Taste, Odor, Calcium, Sodium, Magnesium, Chloride, Carbonate, Sulfate, Laboratory tests, Temperature.

Identifiers: Sensory tests.

Water taste is affected by its mineralization and the form that mineralization takes, such as chloride, sulfate, and carbonate. An extensive research program has been undertaken to measure consumer acceptance of high mineral waters with the introduction of chlorine as an added stimuli. The data collected indicate that the characteristic taste of chlorine in solution can be modified considerably by the specific dissolved minerals in the water. Although results from relatively simple, model systems used herein would be somewhat different in a natural drinking water containing a wider variety of dissolved minerals, as well as organic matter, the data provide an insight on the interactive effects of solution temperature and chlorine concentration. (Goessling-Texas)
W72-01868

THE BIOCHEMICAL ASPECTS OF AEROBIC BACTERIAL GROWTH,

Dow Chemical Co., Midland, Mich. Biochemical and Chemical Research Labs.

W. H. Riley, and M. D. Rickard. Proceedings, Industrial Waste Conference, 20th, May 4, 5, and 6, 1965, p 235-247, 10 fig, 3 ref.

Descriptors: *Water treatment, *Aerobic bacteria, *Bacteria, *Growth stages, Growth rates, Proteins, Laboratory tests, Pure culture, *Aerobic conditions, Microorganisms, Waste water treatment.

Identifiers: Biochemical changes, DNA, RNA, Substrate utilization rate.

To obtain a better understanding of the environmental control of bacterial growth a series of

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Water Quality Control—Group 5G

laboratory experiments have been conducted. AEROBACTER aerogenes ATCC no. 8303 cultures were used throughout these experiments. Periodically throughout the life of the cultures, measurements of DNA, RNA and protein were obtained. It was found that the inoculation of the culture into the medium initiates a chain of biochemical events that results in cellular changes. The cell mass, DNA, RNA and protein increase during the lag phase. It is felt that this cell differentiation is responsible for the delay in cell division (lag phase). During the log growth phase, the increase in population and mass soon changes the environment until it can no longer support the logarithmic increase in cellular material. At this point by some mechanism, as yet unknown, the cell abruptly stops log growth and enters a period of selective synthesis. RNA synthesis stops completely and protein synthesis is temporarily halted. The period of arithmetic growth that follows represents the continued increase in cellular material that is necessary to return to the biochemical composition of the resting phase cell. The characteristic patterns of cell division observed in bacterial populations in liquid culture is a consequence of the conversion between two general physiological states: that of the dividing cell and the resting cell. (Goessling-Texas)
W72-01870

DETERMINING CHLORINE DIOXIDE AND CHLORITE,
Newcastle and Gateshead Water Co., Newcastle-upon-Tyne (England).
A. T. Palin.
Journal of the American Water Works Association, Vol 62, No. 6, June 1970, p 483-484, 3 ref.

Descriptors: *Water purification, Laboratory tests, Analytical techniques, Public health, Hazard, *Disinfection, *Chlorination, Water treatment.
Identifiers: *Chlorine dioxide, Reagents, *Chlorite.

Chlorine dioxide is being increasingly used as a water disinfectant. Residual chlorine dioxide may, however, be accompanied by traces of chlorite, which carries a possible health hazard. In determining chlorine dioxide in water by the DPD method, residuals previously regarded as chlorine dioxide could be due to chlorite. A modification to the DPD method was made previously which meets the requirement to accurately determine the concentrations of the several chlorine compounds in water as the result of chlorine dioxide addition. A detailed discussion of the modified DPD method is presented. The reagents required and procedures for preparing these reagents are presented. The laboratory procedures for measuring chlorine dioxide, free chlorine and chlorine dioxide, monochloramine, dichloramine and total available chlorine (including chlorite), given. The calculations to determine concentrations of each compound are shown. (Goessling-Texas)
W72-01873

VIABILITY OF LONG-STORAGED AIRBORNE BACTERIAL AEROSOLS,
Illinois Univ., Urbana. Dept. of Civil and Mechanical Engineering.
For primary bibliographic entry see Field 05D.
W72-01882

VIRUS REMOVAL BY COAGULATION WITH POLYELECTROLYTES,
Maine Univ., Orono. Dept. of Civil Engineering.
R. T. Thorup, D. F. Trentworth, F. P. Nixon, and O. J. Sproul.
Journal of the American Water Works Association, Vol 62, No. 2, February 1970, p 97-101, 5 tab, 12 ref.

Descriptors: *Water treatment, *Waste water treatment, *Coagulation, *Viruses, Laboratory tests, Bacteriophage, Ions, Calcium chloride, *Electrolytes.
Identifiers: *Polyelectrolytes, Poliovirus.

Much research has been done on methods of eliminating the public health hazard of pathogenic viruses in water. Attention has been directed recently to the use of polyelectrolytes for the treatment of water and waste. Polyelectrolytes have also been used for removing viruses from water. A study has been undertaken to determine the benefits of using polyelectrolytes in conjunction with aluminum sulphate as a coagulant for removing viruses. The results of these experiments are: (1) the cationic polyelectrolyte performed more acceptably than the anionic or nonionic ones; (2) the action of polyelectrolytes as primary coagulants was salt dependent; (3) in instances of poor coagulation, cationic polyelectrolytes exerted a beneficial effect on the formation of flocs and the removal of viruses; (4) virus removals under all circumstances were less than the 99% plus which is usually considered acceptable; and, (5) in instances of adequate coagulation, cationic polyelectrolytes did not increase virus removal beyond that obtained with aluminum sulphate or ferric sulphate alone. (Goessling-Texas)
W72-01886

A CRITICAL EXAMINATION OF BATHING WATER QUALITY STANDARDS,
Tufts Univ., Medford, Mass. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B.
W72-01997

COMPARISON OF PLANT WATER QUALITY TO PROPOSED WATER QUALITY STANDARD,
Sunflower Army Ammunition Plant, Lawrence, Kans.

H. A. Jacob, Jr.
Available from NTIS, Springfield, Va 22151-AD 728511-\$3.00, \$0.95 in microfiche. Hercules Incorporated Sunflower Army Ammunition Plant Final Report SUN 143-10, July 1971. 61 p, 13 tab, 3 chart, 2 ref, 3 append. DOZ Contract DA-11-173-AMC-42 (A).

Descriptors: *Water pollution sources, *Pollutant identification, *Water quality, *Standards, *Industrial water, Kansas, Chemical analysis, Water quality control, Sampling, Data collections, Chemical reactions.

Identifiers: Ammunition Plant.

A program of sampling and testing incoming and outgoing waters of the Sunflower Army Ammunition Plant in Lawrence, Kansas, was conducted for conformity with the requirements set forth in APSA Regulation dated July 16, 1970, ARMY PROGRAMS WATER QUALITY STANDARDS. All incoming and outgoing plant waters were analyzed for 67 constituency during the period September 1970 to February 1971. Those water characteristics which the Sunflower Plant, through its operation, caused to exceed or to approach the APSA standards are tabulated. (Woodard-USGS)
W72-02082

OBJECTIVES AND METHODS OF DATA PROCESSING AND ANALYSIS IN THE WATER TREATMENT CONTEXT,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 06A.
W72-02128

5G. Water Quality Control

WATER GEOCHEMISTRY OF MINING AND MILLING RETENTION IN THE 'NEW LEAD BELT' OF SOUTHEAST MISSOURI,
Missouri Univ., Rolla. Water Resources Research Center.
For primary bibliographic entry see Field 05B.
W72-01692

BIOLOGY OF WATER POLLUTION: A COLLECTION OF SELECTED PAPERS ON

STREAM POLLUTION, WASTE WATER, AND WATER TREATMENT.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W72-01786

ECOLOGY OF PLANT SAPROBIA,
For primary bibliographic entry see Field 05C.
W72-01793

ECOLOGY OF ANIMAL SAPROBIA,
For primary bibliographic entry see Field 05C.
W72-01799

WATER QUALITY REQUIREMENTS FOR RECREATIONAL USES,
Public Health Service, Washington, D.C.
Albert H. Stevenson.

In: Biology of water pollution, p 195-198. Compiled by W M Ingram, L E Keup, and K M Mackenthun, Federal Water Pollution Control Administration, Washington, D C, 1967.

Descriptors: *Water quality, *Standards, *Recreation, Pennsylvania, Legislation, Swimming, Fishing, Shellfish, Camping, Boating, Great Lakes.
Identifiers: Potomac River Basin, Ohio River Basin, Tennessee River Basin, Upper Mississippi River Areas.

Recreational water use includes bathing, fishing, camping and boating. Standards for bathing water quality specify a restricted density of coliform organisms and require the absence of toxic substances, acids, floating solids, oil, and sludge deposits. Fishing grounds should have adequate fish food sources, an adequate concentration of dissolved oxygen, and be free from toxicants and organic sludge blankets. Water used exclusively for camping and boating should have additional requirements--prevention of nuisance conditions and protection of coatings and hulls of floating craft from deterioration. (See also W72-01786)
W72-01807

TRANSFORMATIONS OF IRON BY BACTERIA IN WATER,
New Jersey Agricultural Experiment Station, New Brunswick.
For primary bibliographic entry see Field 02K.
W72-01811

WATER QUALITY MANAGEMENT PLANNING IN SOUTH CAROLINA: A PLANNING MANUAL.
South Carolina State Planning and Grants Div., Columbia. Community Affairs Section.
For primary bibliographic entry see Field 06D.
W72-01825

NAVIGATION PROJECT, NEWARK BAY, HACKENSACK AND PASSAIC RIVERS, NEW JERSEY, (FINAL ENVIRONMENTAL STATEMENT).
Army Engineer District, New York.
For primary bibliographic entry see Field 08A.
W72-01826

PRELIMINARY STUDY OF THE DEVELOPMENT OF WATER RESOURCES OF THE HU-MACAO SUB-REGION, PUERTO RICO.
Black and Veatch International, Kansas City, Mo.
For primary bibliographic entry see Field 06D.
W72-01829

MODEL STUDIES OF OUTFALL SYSTEMS FOR DESALINATION PLANTS (PART I FLUME STUDY),
Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

For primary bibliographic entry see Field 05E.
W72-01838

AERATOR PERFORMANCE IN NATURAL STREAMS, Rutgers-The State Univ., New Brunswick, N.J.

Shaw L. Yu.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No. SA 5, October 1970, p 1099-1114. 8 fig, 2 tab, 12 ref.

Descriptors: *Aeration, *Streamflow, *Saturation, Flow rates, Rivers, Velocity, Mixing, Turbulence, Temperature, Dissolved oxygen, Efficiencies, Sampling, Design criteria, Water pollution control, New Jersey.

Identifiers: *Oxygen transfer rates, *Passaic River (NJ).

Field tests of both mechanical aeration and diffused air aeration were conducted on-stream on the Passaic River. Cross section dissolved oxygen and stream velocity traverses were taken 100 ft upstream and downstream and at 15 to 20 different locations throughout the section. Longitudinal DO traverses were taken at intervals from 1000 to 3000 ft, starting 50,000 ft downstream and 1000 to 5000 ft upstream of the aerator site. Oxygen transfer efficiencies for both surface mechanical aerators and diffused air aerators operating in a natural stream were found to be substantially lower than those found in aeration basins or lagoons. Under standard conditions for low flows, average transfer rates of 2.1 lbs of oxygen/HP-hr for mechanical aeration and 1.2 lbs oxygen/HP-hr for diffused air aeration were obtained. Use of average upstream and downstream DO values in estimating the DO at the aerator was found to give satisfactory results as long as a proper sampling distance was used. Understanding of the particular method used to determine the driving force was therefore demonstrated to be essential to the interpretation of the results. A general efficiency increase for both aerators was noted with increasing river discharge, with the mechanical aerator oxygen transfer coefficient k , increasing substantially for high average stream velocities. Simple procedures, and examples of them, were suggested to aid in converting the commercially specified standard condition transfer rates to actual conditions in order to facilitate design computations. (Lowry-Texas)

W72-01842

PILOT MECHANICAL AERATION STUDIES OF THE JACKSON RIVER IN COVINGTON, WEST VIRGINIA,

West Virginia Pulp and Paper Co., Covington.

O. B. Burns, Jr., D. J. O'Connor, and J. P. St. John. Proceedings, Industrial Waste Conference, 21st, May 3, 4, and 5, 1966, p 799-814. 8 fig, 3 tab, 4 ref.

Descriptors: *Water quality control, *Pulp wastes, Waste water treatment, Effluents, Pulp and paper industry, Activated sludge, Dissolved oxygen, Biochemical oxygen demand, Aeration, Low flow, Efficiency, On site investigations, West Virginia, Industrial wastes, Pollution abatement.

Identifiers: *Covington (W Va).

The program for developing an adequate pollution abatement program for the Covington Mill of West Virginia Pulp and Paper has undergone many changes during the past several years. The activated sludge secondary treatment plant of the mill is operating at peak efficiency. However, marginal DO values are sometimes observed in the Jackson River during periodic and severe drought flow conditions. A pilot program of mechanical aeration for the river in areas of depressed water quality was instituted during 1963. Two raft-mounted 15 HP turbine aerators were installed on pontoons approximately 1.8 miles below the mill. The aerators were operated in parallel from August through November. A river sampling program was conducted during the period of aeration. The aeration units performed satisfactorily and as expected. The mean standard efficiency observed during this survey period was 2.15 lbs O₂/HP-hr at 20 deg C and

zero input DO. Efficient use was made of the oxygen transferred to the stream. An accelerated BOD removal rate was observed downstream from the aerators due primarily to increased stabilization resulting from the addition of DO to previously depicted waters. The investigation of stream mechanical aeration had an associated cost of \$8,500 exclusive of aerator purchases and consulting fees. (Goessling-Texas)

W72-01845

REEVALUATION OF PRADO WATER QUALITY OBJECTIVES, Orange County Water District, Santa Anna, Calif.

D. C. Baier.

Journal of the American Water Works Association, Vol 62, No. 2, p 106-112, February 1970. 12 tab, 14 ref.

Descriptors: *Water quality, *Watersheds, *Water users, Cultivated lands, Industrial use, Domestic water, Salinity, Hardness, Total dissolved solids, Economics, Water softening, Sodium, California, Water pollution control.

Identifiers: *Great Britain.

Orange County's social and economic proportions have been profoundly modified since the Prado water quality objectives were first established in 1956. Similarly, the water use patterns have been modified from irrigated agriculture to urban and industrial uses. The water quality requirements of the new industrial-urban complex are in many instances more demanding than those of agriculture. More than 1,000,000 people live in the OCWD. Domestic use constitutes the largest single category and inexorably, the regulatory agencies must look to drinking water standards as a guide for their objectives for this important domestic water supply source. The OCWD has urged the Santa Anna River Basin Control Board (the agency responsible for water quality in the Santa Anna River at the Prado Dam) to adopt new standards. They are moderate in that, while they are substantial improvements over the present Prado objectives, they are nevertheless lower in quality than requirements for some of the beneficial uses to be protected. (Goessling-Texas)

W72-01850

EFFECT OF URBANIZATION ON STORM WATER PEAK FLOWS, Praca Da Alegria, Lisbon (Portugal).

For primary bibliographic entry see Field 04C.
W72-01857

DISSOLVED OXYGEN VARIATIONS IN STRATIFIED LAKES, Oregon State Univ., Corvallis.

For primary bibliographic entry see Field 05C.
W72-01864

MODEL FOR FLOW AUGMENTATION ANALYSIS-AN OVERVIEW,

Camp, Dresser and McKee, Boston, Mass. George R. Grantham, Edwin E. Pyatt, James P. Heaney, and Buford J. Carter, Jr.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No. SA 5, October 1970, p 1045-1055, 5 fig, 12 ref.

Descriptors: *Low-flow augmentation, *Water quality control, *Stream flow, Computer simulation, Mathematical models, Optimization, Cost analysis, Computer programming, Waste water treatment, Hydrology, Watersheds.

Identifiers: *Subroutines.

Computer-based simulation and optimization models forming a closed-loop information feedback system were used to determine quantitatively the benefits of low flow augmentation for water quality management in a complex river system. For this analysis, flow augmentation benefits were defined as waste treatment costs avoided. Other known benefits, such as recreation and esthetics,

were excluded. The final simulation model consisted of two parts, the first of which generated stream gage data, FLASH, and the second of which simulated regulated stream flows and water quality, WASP. The two programs may be run separately, depending upon the limitations in computer storage. Unregulated flows were corrected appropriately for an upstream regulation by programming the volume-depth-area characteristics and operating rules of reservoirs and other regulating devices. Water quality was simulated by input of waste loads and associated constants at various reach points. Waste loads may be time-constant or varied either by direct input of values for each time frame or development of a mathematical model. Optimization programs, including treatment capacities and costs, were then developed into an optimization mode. Future work should include cost estimates for the intangible benefits to provide a more accurate picture. (Lowry-Texas)

W72-01874

THE PREVENTION OF POLLUTION IN ESTUARIES, Roy H. Oakley, and Ian W. M. Moir.

Water Pollution Control, Vol 70, No. 4, p 426-437, 4 fig, 1 tab, 19 ref.

Descriptors: *Industrial wastes, *Municipal wastes, *Estuaries, *Water quality control, Administration, Planning, Legislation, Stratification, Turbulence, Mixing, Public health, Pollution abatement.

Identifiers: *Great Britain.

An investigation of 5 estuaries in England was made to determine the effects of both industrial and municipal discharges on the quality of the water. Because of the many disciplines and skills involved, the joint action of engineers, hydrographers, chemists, biologists, and mathematicians was necessary and the recommendation that the Public Health engineer might well be the leader and director of the team was made. Proper investigations of such estuaries was necessarily preceded by a comprehensive hydrographical survey and by determination of the chemical and biological state of the estuary in varying conditions. Development of a model to describe steady state conditions at a particular state of the tide cycle greatly facilitated load predictions, but considerable uncertainty as to some of the more complex chemical and biological changes in the estuary indicated that further basic research work is necessary to avoid wasted effort. (Lowry-Texas)

W72-01883

NATURAL RESOURCE CONSERVATION: AN ECOLOGICAL APPROACH, For primary bibliographic entry see Field 06G.

W72-01896

WATER RESOURCES POLICY IN WISCONSIN: A SUMMARY ASSESSMENT, VOLUME 1, Wisconsin Univ., Madison. Water Resources Center.

For primary bibliographic entry see Field 06E.
W72-01979

GAS-PHASE CATALYTIC OXIDATION OF PHENOL IN DILUTE CONCENTRATIONS WITH WATER VAPOR, Delaware Univ., Newark. Dept. of Chemical Engineering.

For primary bibliographic entry see Field 05D.
W72-02050

HYDROLOGIC EFFECTS OF WATER CONTROL AND MANAGEMENT OF SOUTHEASTERN FLORIDA, Geological Survey, Tallahassee, Fla.

For primary bibliographic entry see Field 04A.
W72-02090

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Water Quality Control—Group 5G

AGRICULTURAL UTILIZATION OF SEWAGE EFFLUENT AND SLUDGE, AN ANNOTATED BIBLIOGRAPHY,

Robert S. Kerr Water Research Center, Ada, Okla.
James P. Law, Jr.

Copy available from NTIS as PB-205 028, paper copy \$3.00; microfiche \$0.95. Federal Water Pollution Control Administration, Report No. CWR-2, January 1968. 89 p. FWPCA Program 16080--01/68.

Descriptors: *Water reuse, *Reclaimed water, *Sludge disposal, Pollution abatement, Irrigation water, Nutrients, Agricultural engineering.

Identifiers: *Land disposal, Soil conditioners.

The effluent and sewage sludge from municipal and industrial treatment plants is a source of water and nutrients for agricultural uses. Considering its potential, only a few instances of agricultural uses of waste water in crop production have been recorded. Most of the literature on this subject is by scientists in the sewage disposal field. This report brings together 284 annotated references on the agricultural uses of sewage effluents and sludge. Such uses aid crop production, but also make use of water that would have been wasted, decrease the pollutant load on the receiving streams, and preserve the normal stream flow for downstream uses. The abstracts in each section are arranged, first, in chronological order (based generally on 5-year periods) and, second, in alphabetical order by author's surname for each chronological grouping. An author index is included at the end. (EPA abstract)
W72-02104

VESSEL AND AIRCRAFT GARBAGE.

For primary bibliographic entry see Field 06E.
W72-02122

ON THE ECONOMIC IMPACT OF LARGE DIVERSIONS OF SNAKE RIVER WATERS,

Washington State Univ., Pullman. Water Research Center.

For primary bibliographic entry see Field 06D.

W72-02124

VALIDATION OF POLITICAL SIMULATION MODELS - WATER RESOURCE PROJECTS,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.

For primary bibliographic entry see Field 06A.

W72-02129

ECONOMICS AND POLITICS IN WATER POLLUTION CONTROL,

Clemson Univ., S. C.

J. M. Stepp.

Paper presented at Southeastern Section, Technical Association of the Pulp and Paper Industry, November 21, 1969, Augusta, Georgia. 12 p. OWRR A-017-SC (2).

Descriptors: *Water quality act, *Political aspects, *Economic impact, *Pollution abatement, *Separable costs, Water law, Water pollution sources, Water pollution control, Equitable apportionment, Welfare (Economics).

Water pollution regulations as embodied in the Federal Water Pollution Control Act of 1965 are potentially damaging to the economies of many parts of the nation. Treating water pollution as a national rather than regional problem results in an inequitable distribution of the cost of pollution abatement. As an example, taxpayers in the relatively pollution-free Southeast may be forced to pay part of the cost of cleaning up the Northeast's polluted rivers, regardless of the purely regional nature of this type of pollution. Furthermore, a national as opposed to a regional view of the pollution problem implies that clean streams of, say, the underdeveloped Southeast are national assets whose quality should be maintained at, or above, existing

levels. If these beliefs are made public policy, as the Pollution Control Act seems to make them, industrial development of currently underdeveloped regions would be slowed, if not halted entirely. Thus, a definite bias would exist in favor of already developed areas and regions which have fully or overly utilized their surface waters for waste disposal. These potentially damaging policies may be attributed to the careless oversight of an enthusiastic conservationist or to the successful scheme of a cunning politician. (Settle-Wisconsin)
W72-02135

THERMODYNAMICS OF ENVIRONMENTAL DEGRADATION,

National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center.

R. F. Mueller.

Available from National Technical Information Service, Springfield, Va. 22151, as N71-23346, \$3.00 paper copy, \$0.95 in microfiche. NASA TM X-65492, March 1971 Presented at: Annual Meeting, American Geophysical Union, 1971, Washington, D. C. 14 p, 1 fig, 13 ref.

Descriptors: *Pollution abatement, *Economics, *Technology, *Thermodynamics, Ecology, Energy transfer, Entropy, Costs.

Identifiers: *Environmental degradation, *Economic policy, Recycling, Pollution control devices.

Since technology can be regarded as a heat engine, it is subject to thermodynamic principles which govern energy transformations. Through human intervention, natural materials acquire energy in excess of what they would otherwise possess. Pollution is the agent by which total energy input is dissipated into the environment. 'High energy' pollution abatement programs (e.g., recycling or pollution control devices) now in vogue are characterized by an undiminished energy flux and expanding technology. In contrast, the 'economy' processes depend on a diminished energy flux through diminished goods and services resulting in unpopular inconveniences. Present general economic policy takes no account of the ultimate disposal of resources utilized by technology. This policy and the high-energy abatement concept are incompatible with the ecologic view (stressing balance and nearly closed cycles in resource utilization) and ignore thermodynamic laws. New economic policies must be formulated to take into account the cyclic system of nature and minimize the energy flux which feeds technology. The prices for marketed goods should also include the costs of their disposal. In this way pollution abatement will be directly paid for and total resource consumption reduced by increasing the value of goods. (Haugh-Wisconsin)
W72-02137

POLLUTION CONTROL ACT.

For primary bibliographic entry see Field 06E.
W72-02139

A BILL TO AMEND THE FEDERAL WATER POLLUTION CONTROL ACT TO PROVIDE FINANCIAL ASSISTANCE FOR RIVER BASIN PROGRAMS.

For primary bibliographic entry see Field 06E.
W72-02141

A WELTER OF IDEAS--A MODICUM OF COORDINATION,

Du Pont de Nemours (E.I.) and Co., Delaware, Md.

D. B. Sebree.

In: Proceedings of the Conference on International and Interstate Regulation of Water Pollution, March 12-13, 1970, Columbia University School of Law, New York, New York, p 277-280. 4 p.

Descriptors: *Administrative agencies, *Water pollution control, *Water quality control, *Environ-

mental sanitation, Federal government, State governments, Administration, Administrative decisions, Regulation, Standards, Air pollution, Water pollution, Water quality, Pollution abatement, Waste disposal, Industrial wastes, Water law, Legal aspects, Municipal wastes, Farm wastes, Coordination, Institutional constraints, Industries.

Numerous federal agencies are responsible for various phases of pollution control, and there is also an abundance of state legislation in this area. Industry is placed in the difficult position of trying to please the many agencies involved, and it is hesitant about spending money until it is sure that it is following an appropriate course of action. Bickering between state and federal governments, and departments within the same level of government, slows down the elimination of pollution. A coordinated approach is needed. Laws should expand from a basic theme and on the basis of need. They should not proliferate and change so rapidly. The federal government should provide leadership through a unified environmental control program which establishes the basic objective of clean air and clean water. States, under federal leadership, should establish emission control programs. Injunctive authority should be given to move against violators. Methods of control must be coordinated so that one control technique will not create a pollution problem in another area. (Robinson-Florida)
W72-02151

ORSANCO--1970.

22nd Yearbook, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, 1970. 36 p, 8 fig, 13 tab, 28 chart.

Descriptors: *Ohio River, *Interstate compacts, *Interstate commissions, *Water pollution control, Interstate, Water policy, Water resources, Water resources development, Water pollution, Water quality, Water quality control, Environmental sanitation, Standards, Regulation, Administrative agencies, Water pollution treatment, Treatment facilities, Subsurface waters, Thermal pollution, Municipal wastes, Industrial wastes.

The Ohio River Valley Water Sanitation Commission, an interstate compact agency, herein highlights the activities and findings of 1970. Policy revisions are described, including a call for secondary treatment of all discharges of municipal sewage and industrial waste. New quality standards were promulgated in order to comply with federal statutes. Requirements were devised to prevent thermal pollution through a quantitative basis for allowable heat output from a discharge. A staff report prompted new regulations concerning subsurface waste disposal. The status of sewage treatment facilities is summarized. A detailed analysis of a river quality model demonstrates the advantages of water quality forecast procedures. A comprehensive appraisal of quality conditions in the Ohio River and some of its major tributaries during 1969 is presented. Among the factors analyzed are river flow, visible aspects of pollution, dissolved oxygen, coliform density, dissolved solids, chemical contents, odor, pH, and temperature. An inventory of pollution control facilities along the River is compiled. Also included are a summary of Administrative affairs and a financial report. Significant progress has been made by the Commission in improving the quality of the Ohio River system. (Smiljanich-Florida)
W72-02152

NATIONAL WATER QUALITY STANDARDS ACT OF 1971.

House Bill 4387, 92d Cong, 1st Sess (1971). 50 p.

Descriptors: *Water quality control, *Water pollution control, *Standards, *Grants, *Federal government, Treatment facilities, Government finance, State governments, Planning, River basins, Administrative agencies, Regulation, Pollution abatement, Water pollution sources, Public health, Adjudication procedure, Court decisions, Con-

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

struction costs, Damages, Remedies, Foreign countries, Inspection, Technology, Population, Water users.
Identifiers: *Water Pollution Control Act.

In amending the Federal Water Pollution Control Act this Bill serves several purposes: (1) providing for the establishment and periodic revision of water quality standards for waterways; (2) renewing and expanding federal assistance for the construction of waste treatment facilities; (3) assisting in planning and implementing water pollution control and water quality enhancement programs; (4) cooperating with states in improving enforcement measures; and (5) assuring public participation in federal programs to develop, establish, and enforce water quality enhancement programs; (6) cooperating with states in improving enforcement measures; and (7) assuring public participation in federal programs to develop, establish, and enforce water quality enhancement measures. Section 7 is amended to read 'Grants for Water Quality and Pollution Control Programs'. The means to establish water quality standards and develop programs to prevent, control, and abate water pollution are detailed. The means to determine grant allocations for each state, based upon population and extent of pollution, are discussed. Section 8 is entitled 'Grants for Construction of Treatment Works', and the means to determine recipients of grants and the respective amounts are discussed. Section 10 is entitled 'Water Quality Control and Enhancement', and the duties of the Administrator and the states in establishing plans are detailed. A new section outlines federal enforcement procedures through compliance orders, hearings, and civil actions. (Rees-Florida)
W72-02154

INDUSTRY/GOVERNMENT TELECONFERENCE ON POLLUTION CONTROL.

Proceedings, National Telecast and Local Panel Sessions, National Association of Manufacturers, New York, New York, May 26, 1971. 138 p, 41 photo.

Descriptors: *Industrial wastes, *Water pollution control, *Air pollution, *Conferences, Legislation, Industry, Federal government, Administrative agencies, Administrative decisions, State governments, Rivers and Harbors Act, Water pollution, Water pollution effects, Water pollution treatment, Pollutants, Pollution abatement, Waste disposal, Remedies, Water Quality Act.

Identifiers: Refuse Act, Water Pollution Control Act.

The National Association of Manufacturers (NAM) conducted a closed-circuit teleconference on pollution control. The teleconference consisted of five panel discussions. The first discussion was between the Chairman of the President's Council of Environmental Quality and the presidents of Universal Oil Products and Allied Chemical. It concerned the abatement of industrial pollution. A panel discussion on administering the 1970 amendments to the Air Pollution Control Act followed; one of the panelists was the Administrator of the Environmental Protection Agency. The Chairman of the Senate Subcommittee on Air and Water Pollution Control also participated in a discussion on federal pollution control legislation. The remaining panel discussions concerned the implementation and enforcement of the Refuse Act and the Federal Water Pollution Control Act. The federal government was represented by the Administrator and General Counsel of the Environmental Protection Agency and the Army Chief of Engineers. Sub-panels were present in 22 cities during the teleconference. Edited transcripts of questions and answers following the discussions are included in the report. (Hart-Florida)
W72-02155

SOUTH AFRICA AND ITS WATER PROBLEM (L'AFRIQUE DU SUD ET LE PROBLEME DE L'EAU),
For primary bibliographic entry see Field 04A.
W72-02099

MANAGEMENT OF ARTIFICIAL RECHARGE WELLS FOR GROUNDWATER QUALITY CONTROL,

Arizona Univ., Tucson. Water Resources Research Center.

L. G. Wilson.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 261-268, 1971. 2 fig, 5 ref.

Descriptors: *Groundwater recharge, *Mixing, *Waste dilution, *Nitrates, *Discharge (Water), Arizona, Arid lands, Water wells, Chlorides, Pumped storage, Chemical waste, Chemical properties, Water quality control, Water chemistry, Modes of action.

Identifiers: *Recharge wells, *Chemical mixing.

Recharge wells may be used in various problems relating to chemical water quality because of the phenomenon of in-aquifer mixing. This paper reviews specific recharge well-mixing techniques of possible utility in underground mixing operations for nitrate control. Illustrative data from field studies at a recharge site near Tucson, Arizona are presented. Both single- and 2-well types of mixing were investigated. In single-well operations, effluent recharge and pumping of the subsequent mixture occur at the same well. Differences in Chlorine ion levels were used to distinguish between recharge effluent and native groundwater. Undiluted effluent was discharged in single-well operations until a pumped volume ratio of about 0.4 was attained. Dilution increased steadily with increased pumping and the relative concentration versus pumped volume curve was S-shaped. Seven-day pauses after effluent recharge resulted in immediate pumping of almost completely diluted water, probably because groundwater movement swept the effluent beyond the pumping unit during the pause. With 2-well pumping, the Chlorine breakthrough curve reached a constant level at about 13 days and was close to that of the pause-type, single-well regime. (See also W72-02212) (Casey-Arizona)
W72-02228

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

MULTI-SITE STREAMFLOW SIMULATION OF TRUCKEE RIVER, NEVADA,

Nevada Univ., Reno. Center for Water Resources Research.

For primary bibliographic entry see Field 02E.

W72-01778

A CRITICAL REVIEW OF CURRENTLY AVAILABLE HYDROLOGIC MODELS FOR ANALYSIS OF URBAN STORMWATER RUNOFF,

Hydrocomp International Inc., Palo Alto, Calif.

For primary bibliographic entry see Field 02A.

W72-01978

MULTIRESERVOIR ANALYSIS TECHNIQUES IN WATER QUANTITY STUDIES,

Saskatchewan-Nelson Basin Board, Regina.

For primary bibliographic entry see Field 04A.

W72-02057

A CLASS OF PROBABILITY MODELS FOR LITTORAL DRIFT,
Army Coastal Engineering Research Center, Washington, D.C.
W. R. James.

Proceedings, Twelfth Coastal Engineering Conference, Wash., D.C., Sept. 1970, p 831-37; and CERC Reprint 7-71, Sept. 1970.

Descriptors: *Mathematical models, *Tracers, *Sediment transport, *Littoral drift, Beaches, Shores.

Identifiers: Sediment tracers, Probability models.

Quantitative determination of volume littoral drift rate requires a development of sediment tracer technology in which a mathematical model is used to relate the flux of tracer material to the sediment flux. The concepts and mathematical relationships basic to development of this kind of mathematical model are described based upon the assumption of a two dimensional sediment transport system which includes only depth of burial and transport direction.
W72-02121

OPTIMIZATION IN MUNICIPAL WATER SUPPLY SYSTEM DESIGN,

Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.

R. N. DeVries, and C. G. Clyde.

Water Resources Bulletin, Vol. 7, No. 5, p 1048-1058, October 1971. 3 fig, 5 tab, 6 ref.

Descriptors: *Optimization, *Mathematical models, *Systems analysis, *Linear programming, *Aqueous, *Artificial recharge, Water shortage, Economic efficiency, Future planning (Projected).
Identifiers: *Lincoln, Nebraska.

This study formulated, solved and evaluated a mathematical design model of a municipal water supply system that included a supply from a variable quality output desalting plant. Design optimization required the model to be formulated to use systems analysis methods. The model was set up in an approximate linear programming format. Its objective was to supply the needed demand volumes at the least cost and yet not exceed the constraints placed on the combined system. The objective was achieved. The model was tested by applying it to the design of a supply system to meet the 1985 projected water demand of Lincoln, Nebraska. The combined conventional system was operated in conjunction with an artificially recharged aquifer reservoir and is capable of supplying that demand except during the peak period. Short periods of water shortages were considered and an electrodialysis desalting system was used. Eight schemes were analyzed by the model system, however, it was competitive only when the new conventional supply pipeline was increased to a length of 90 miles. (Markell-Cornell)
W72-02125

EMPIRICAL STUDY OF ECONOMIC-ECOLOGIC LINKAGES IN A COASTAL AREA,

Clemson Univ., S.C. Dept. of Agricultural Economics.

J. C. Hite, and E. A. Laurent.

Water Resources Research, Vol. 7, No. 5, p. 1070-1078, October 1971, 6 tab, 11 ref, 1 append.

Descriptors: *Computer models, *Leontief models, *Input-output analysis, *Economics, *Ecology, City planning, Regions, Data, South Carolina.
Identifiers: Charleston (South Carolina).

This study's objective was to evaluate the environmental impact of possible changes in the economic structure of the Charleston area. The empirical implementation of an input-output model of economic-ecologic linkages for the Charleston, South Carolina metropolitan area was reported. Two essential elements contained in the model were the Leontief inverse of an input-output matrix of the area economy and a matrix showing the en-

WATER RESOURCES PLANNING—Field 06

Techniques of Planning—Group 6A

vironmental inflow and residual outflow to the environment associated with one dollar of gross output of each sector in the input-output matrix. Post multiplication of the environmental linkages matrix by the Leontief inverse achieved model implementation. Survey data from 1968 transactions for the Charleston area were used to construct a 28-sector input-output matrix. The results showed that both direct and indirect changes following from changes in the area's economic structure have a cumulative effect on the local environment. The study further provided an estimation of environmental repercussions from alternative changes in the local economy. (Markell-Cornell)
W72-02126

MATHEMATICAL FOUNDATIONS FOR DESIGN: CIVIL ENGINEERING SYSTEMS, Delaware Univ., Newark, N. J. Dept. of Civil Engineering.

R. M. Stark, and R. L. Nicholls.
McGraw-Hill, New York, N.Y. 1972. 565 p.

Descriptors: *Mathematical models, *Design, *Optimization, *Linear programming, *Dynamic programming, *Operations research, Wastewater treatment, Flood control.

Identifiers: *Geometric programming, LaGrange, Kuhn-Tucker, Newton-Raphson.

Operations research and systems engineering techniques which are applicable to the design and operation of systems of interest to civil engineers, such as water resource design and operation, were developed in this text. A wide variety of problem solving examples were presented. For example, in Chapter 3 a problem was developed which used linear programming to determine the levels of treatment which treatment plants must maintain to satisfy the specified stream-quality criteria at minimum total cost. Nonlinear optimization problems and techniques were discussed in Chapter 5. A flood control optimization problem was presented and geometric programming, which finds the optimal way to distribute total cost among the various terms in the objective function rather than finding the optimal values of the variables directly, was used to determine the minimum flood cost. Graphic-analog methods were used to solve a hydroelectric design problem. In Chapter 6 dynamic programming was used to size an irrigation aqueduct and allocate water from it. Annual water delivery to each irrigation district and corresponding aqueduct capacity were chosen to maximize anticipated annual profit. Solution was obtained by considering first the size of the last segment of aqueduct and proceeding stepwise to the first segment of aqueduct. (Markell-Cornell)
W72-02127

OBJECTIVES AND METHODS OF DATA PROCESSING AND ANALYSIS IN THE WATER TREATMENT CONTEXT, Institute of Hydrology, Wallingford (England).

R. T. Clarke.

The Journal of the Society for Water Treatment and Examination, Vol. 20, Part 2, p. 95-107, September 1971, 3 tab, 19 ref.

Descriptors: *Data processing, *Input-output analysis, *Decision making, *Water treatment, *Water quality control, *Time series analysis, Computer models, Sequential generation, Forecasting.
Identifiers: Gaussian.

This article discussed the role of data processing in decision-making as related to the water treatment industry. The data with which the article was concerned were values assumed by particular variates (total hardness, turbidity, numbers of particular species of algae) at discrete intervals of time, equal or unequal, long or short. Defining a model as a simplified representation of a complex system, which contains a set of parameters particular to the system being modelled, the paper proposed that in addition to collecting data for water quality control collection and analysis of data should be carried on

for the purpose of constructing a model of the system being operated. This would permit continual comparisons of predictions based on the model with what is observed by measurement. Advantages of such a model would include insight into the combinations of system state and river water quality which could cause deterioration of treated water quality and the prediction of the outcome of a given decision or comparison of the outcomes of alternative decisions. The necessary steps for fitting an empirical model were listed and the mechanics of data processing for model building described. The computer package used for illustration was ASCOP. (Markell-Cornell)
W72-02128

VALIDATION OF POLITICAL SIMULATION MODELS - WATER RESOURCE PROJECTS, Michigan Univ., Ann Arbor. Dept. of Civil Engineering.

J. W. Bulkley, and J. Antill.
Water Resources Bulletin, Vol. 7, No. 5, p. 1071-1080, October 1971. 3 tab, 6 ref.

Descriptors: *Computer models, *Political aspects, *Simulation analysis, *Resource allocation, *Michigan, *Water pollution control, Institutions, Data collections, Systems analysis.

The critical role of political processes in water resource projects requires systematic analysis in order to improve our ability to implement water projects. This paper reported the validation of an existing computer simulation model designed to replicate political interactions in resource allocation problems. The objective was achieved by comparing the results of observed situations to those outcomes simulated by the political model. The model was issue oriented and reflected the theory that conflict (within bounds) is an essential component of the political process. It was composed of six basic elements: position matrix, political power coefficient, conflict identification, political interaction, coalition formation, generation of proposed reallocation. Five basic issues associated with the formulation and enabling legislation stages of the 1968 Michigan Bond Issue for Water Pollution Control were selected for model validation. The data presented indicated that the computer model realistically predicted the outcomes of the issues tested. It was concluded that the model is a potentially useful tool in the examination of political consequences related to large-scale water resource projects. However, further testing and refinement is necessary. (Markell-Cornell)
W72-02129

IRRIGATION PLANNING 2: CHOOSING OPTIMAL ACREAGES WITHIN A SEASON,

Montana State Univ., Bozeman. Dept. of Economics and Agricultural Economics.
N. J. Dudley, D. T. Howell, and W. F. Musgrave.
Water Resources Research, Vol. 7, No. 5, p. 1051-1063, October 1971, 6 fig, 1 tab, 8 ref.

Descriptors: *Optimization, *Simulation analysis, *Dynamic programming, *Linear programming, *Least squares method, *Irrigation, *Soil-water-plant relationships, Estimating, Economic efficiency.

A simulation-dynamic programming model designed to give optimal solutions to the intermediate-run irrigation problem of selecting the best combination of irrigation and dryland acreages to plant in any season in which the beginning-season reservoir contents are at a particular level was presented. A simple crop growth simulation model was used over a number of years on a large acreage subject to stochastic reservoir inflows and stochastic crop water demand. The model was applied to a hypothetical problem and actual streamflow data and reservoir characteristics were used. An optimality-approximating technique was developed. Irrigation decision rules at each of a number of decision points were taken from the output of the dynamic programming model used to

solve the short-run problem. The results showed that the best acreage to plant is an approximately linear function of the beginning-season reservoir level. This function is highly sensitive to changes in profitability of the alternative dryland crop. Further, using the least squares method it was found that the cost of planting suboptimal acreages was high. A major limitation of the approach used was its failure to allow a portion of the crop to go temporarily unirrigated. Also, it did not allow for reinstatement during the season. (Markell-Cornell)
W72-02130

THE SIMULATION AND OPTIMIZATION OF A SINGLE EFFECT MULTI-STAGE FLASH DESALINATION PLANT, Stanford Univ., Calif.

J. H. Beamer, and D. J. Wilde.
Desalination, Vol 9, p 259-275, 1971. 4 fig, 1 tab, 8 ref.

Descriptors: *Simulation analysis, *Optimization, *Mathematical models, *Linear programming, *Desalination plants, Economic efficiency.

Identifiers: LaGrange, Kuhn-Tucker.

A physical and economic model was constructed for a 150 million gallon per day single effect multi-stage flash desalination plant. The development of the model was reviewed from previous papers. A combination of two techniques, the discrete maximum principle and direct search optimized the model and lead to the development of an efficient algorithm which optimized over 100 variables in the optimum plant of 60 stages and 30 vessels. Unlike previous studies which considered about five variables, the method used in this study permitted optimization of the design variables at each stage, e.g. stage length, tube diameter and heat transfer. The objective function was to maximize the negative cost. The cost was reduced by 3% or one cent/magal of product water. A sensitivity analysis was performed on the constraints on maximum brine temperature, maximum salinity of the recycle and maximum product water temperature indicating those areas in which the greatest cost reductions could be obtained. Results of the optimization were given and the limitations of the model discussed. (Markell-Cornell)
W72-02131

DIGITAL SIMULATION OF AN EXISTING WATER RESOURCES SYSTEM,

Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.

A. J. Fredrich.
Paper presented at IEEE Joint National Conference on Major Systems. 29 p, 7 plates.

Descriptors: *Simulation analysis, *Digital computers, *Operations research, *Reservoir operation, *Water resources, Basins, Hydrologic data, Flood control, Hydroelectric power.

Identifiers: *Arkansas, White and Red River Basins.

A review of the operation of the existing reservoir system in the Arkansas, White and Red River basins was presented. The system is composed of 23 reservoir projects. Presently, flood control, navigation and hydroelectric power production are considered the primary demands. Digital simulation was used to analyze and evaluate the operation of the system. The procedure involved postulating an operation plan, operating the simulation model to determine the results of the plan, evaluating the results in terms of the desired operation objectives, modifying the proposed plan to rectify any errors or inconsistencies in the policy as indicated by the results of the simulation study and repeating the process until the desired objectives were realized. Basic physical, climatologic and hydrologic data were collected, analyzed and prepared for use in a computer study. It was concluded that simulation is an effective tool for studying the operation of existing water resource systems, however, further research must be done to identify explicit operation

Field 06—WATER RESOURCES PLANNING

Group 6A—Techniques of Planning

objectives and identify and quantify parameters to measure whether the objective is being satisfied. (Markell-Cornell) W72-02132

CONDITIONAL STREAMFLOW PROBABILITY DISTRIBUTIONS, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources. T. G. Roefs, and D. M. Clainos.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 153-170, 1971, 6 fig, 13 ref. OWRR A-024-ARIZ (1).

Descriptors: *Probability, *Stochastic processes, *Streamflow, *Decision making, *Statistical models, Mathematical studies, Flow characteristics, Variability, Simulation analysis, Optimization, Reservoirs, Planning.

Identifiers: *Conditional probabilities, *Flow intervals.

Streamflows of monthly or shorter time periods, are, in most parts of the world, conditionally dependent. In studies of planning, commitment and operation decisions concerning reservoirs, it is probably most computationally efficient to use simulation routines for decisions of low dimensions, as planning and commitment, and optimization routines for the highly dimensional operation rule decisions. This presents the major problem of combining the 2 routines, since streamflow dependencies in simulation routines are continuous while the direct stochastic optimization routines are discrete. A stochastic streamflow synthesis routine is described consisting of 2 parts: streamflow probability distribution and dependency analysis and a streamflow generation using the relationships developed. A discrete dependency matrix between streamflow amounts was then sought. Setting as the limits of interest the class 400-500 thousand acre ft in January and 500-600 thousand acre ft in February, and using the transforms specified, the appropriate normal deviates were determined. The next serious problem was calculating the conditional dependency based on the bivariate normal distribution. In order to calculate the joint probability exactly, double integrations would be required and these use too much computer time. For the problem addressed, therefore, the use of 1-dimensional conditional probabilities based on the flow interval midpoint is an adequate and effective procedure. (See also W72-02212) (Casey-Arizona) W72-02223

A STOCHASTIC ANALYSIS OF FLOWS ON RILLITO CREEK, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources. For primary bibliographic entry see Field 02E. W72-02224

OPTIMAL UTILIZATION OF PLAYA LAKE WATER IN IRRIGATION, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources. For primary bibliographic entry see Field 03F. W72-02231

COLLECTIVE UTILITY: A SYSTEMS APPROACH FOR THE UTILIZATION OF WATER RESOURCES, Arizona Univ., Tucson. Dept. of Systems Engineering. For primary bibliographic entry see Field 04B. W72-02232

6B. Evaluation Process

ENVIRONMENT CRISES, Ohio State Univ., Columbus. Disaster Research Center.

Russell R. Dynes, and Dennis Wenger.

Available from the National Technical Information Service as PB-204 891, \$3.00 in paper copy, \$0.95 in microfiche. Ohio Water Resources Center, Columbus, Project Completion Report No 118, Jan 19, 1971. 91p, 24 tab. OWRR-B-012-OHIO (1).

Descriptors: *Decision making, Social change, *Social values, *Leadership, Water resources development, *Community development, Institution, Institutional constraints, Organizations, Administration.

Results are presented of a study of the perception of community problems, including flooding and pollution, among community leaders in four different communities, ranging in size from 10,000 to 20,000 population. Water related problems were considered in the context of other community problems which were defined by these leaders. Among these leaders, water related problems were characterized by low salience and by low consensus. In seeking solutions, these leaders see water problems as being less likely to be solved at the local community level and as necessitating extra-community assistance. They also see water related problems as requiring a relatively low level of community coordination and as being primarily the responsibility of the public sector. Local governmental leaders were seen as being more important in problem solving in water related problems than they were in other community problems. The report also reprints two articles originally published in: Water Resources Bulletin, Vol 7, No 4, Aug 1971, p 646-651, and Proceedings of the 1968 Water Resources Colloquium, Information Report No. 57, Pennsylvania Inst. for Research on Land and Water Resources, University Park, Pa. W72-01694

A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS: LANDOWNER PERCEPTION OF RECREATIONIST ASSOCIATED CONFLICTS IN THE SALMON-LITTLE SALMON RIVER CORRIDOR OF IDAHO, Idaho Univ., Moscow. Dept. of Geography. E. P. Wehnt, Jr.

Idaho Water Resources Research Institute, Moscow, 92 p., January 1971. 9 fig, 18 tab, 29 ref. (M.S. thesis). OWRR B-014-IDA (10). W72-02028

Descriptors: *Evaluation, *Water management (Applied), *National Forests, *Recreation demand, *Land management, Benefits, Idaho, Canyons, Ranges, Livestock, Recreation facilities, Recreation wastes, Hunting, Camping, Fishing, Access routes, Land use, Deer, Camp sites, Waste disposal, Municipal water, Wild River Act.

Idaho's Salmon-Little Salmon River Corridor is a complex of management and ownership units adjacent to national forest land, characterized by laterally limited mobility of canyon-bounded land and water strips. The northern corridor is ranch land, and the southern corridor is residential land. Landowner sampling indicates that gates left open, vehicles not restricted to roads, and disturbance to livestock by hunters, cyclists and campers are perceived as main sources of problems in the northern corridor. Vandalism by hunters, cyclists and campers is the major problem in the fisherman-dominated southern corridor. Two-thirds of all landowners believe existing roads provide adequate access and intensify land management problems. Hunting regulations were considered to have adverse effects on land use practices and deer population. Land-owner-recreationist conflicts are influenced by inadequate supply of roadside rest areas, campgrounds, toilets, litter disposal, and drinking water. Recommendations include specified facilities, action, awareness, involvement,

determination, and research to alleviate landowner-recreationist conflicts. (Popkin-Arizona) W72-01746

MINIMUM DESIGN STANDARDS FOR COMMUNITY WATER SUPPLY SYSTEMS (EXISTING STANDARD-FHA 4517.1) (DRAFT ENVIRONMENTAL STATEMENT).

Department of Housing and Urban Development, Washington, D.C. Assistant Secretary for Housing Production and Mortgage Credit.

For primary bibliographic entry see Field 05F. W72-01822

OSO CREEK TECHNICAL ASSISTANCE STUDY: PRELIMINARY STUDY ON THE PROBLEMS AND OPPORTUNITIES FOR DEVELOPMENT OF OSO CREEK AND OSO BAY.

Coastal Bend Regional Planning Commission, Corpus Christi, Tex.

Available from National Technical Information Service, Springfield, Va., 22151, as PB-201 213, \$3.00 paper copy, \$0.95 in microfiche. Coastal Bend Regional Planning Commission Report, March 1971. 11 p.

Descriptors: *Water resources development, *Watershed management, *Planning, *Texas, Water pollution control, Flood control, Urbanization, Land development, Ecology, Agriculture, Industries, Water users, Recreation, Evaluation.

Identifiers: *Oso Creek basin (Nueces County, Tex), Urban hydrology.

This preliminary study recommends that the problems and opportunities for development of Oso Creek and Oso Bay in Nueces County, Texas should be undertaken as a coordinated and comprehensive effort and should include consideration of the plans and programs of the County, its municipalities and the region, whether existing or proposed. The plan should take into consideration existing and potential social, economic, and environmental values of the Oso watershed. Particular attention should be directed to questions of conservation, protection of exhaustible resources, and the effects of development on the eco-system of the Creek, the Bay and the area. Such items as: recreation; open space; ecological and estuarine control and development; urban, industrial, and agricultural pollution; flood prevention and control; and the protection of agricultural enterprise, should be investigated. (Woodard-USGS) W72-02028

A SYSTEM ANALYSIS OF APPLICATIONS OF EARTH ORBITAL SPACE TECHNOLOGY TO SELECTED CASES IN WATER MANAGEMENT AND AGRICULTURE-VOLUME 1, TECHNICAL SUMMARY.

Planning Research Corp., Washington, D.C. For primary bibliographic entry see Field 07B. W72-02029

ON THE ECONOMIC IMPACT OF LARGE DIVERSIONS OF SNAKE RIVER WATERS, Washington State Univ., Pullman. Water Research Center.

For primary bibliographic entry see Field 06D. W72-02124

OUTDOOR RECREATION IN NEW YORK STATE: PROJECTIONS OF DEMAND, ECONOMIC VALUE, AND PRICING EFFECTS FOR THE PERIOD 1970-1985, Cornell Univ., Ithaca, N.Y.

R. J. Kalter, and L. E. Gosse.

Toward the Year 1985, Special Cornell Series Number 5, New York, State College of Agriculture, A Statutory College of the State University at Cornell University, 57 p, 1 fig, 19 tab, 116 ref, 13 append. OWRR B-014-NY (1).

WATER RESOURCES PLANNING—Field 06

Cost Allocation, Cost Sharing, Pricing/Repayment—Group 6C

Descriptors: *Recreation demand, *New York, *Regression analysis, Estimating, Methodology, Hunting, Swimming, Boating, Fishing.
Identifiers: Hiking.

Econometric demand functions for hiking, hunting, swimming, boating, and fishing in New York State are estimated from data gathered by the Census Bureau in special 1960 and 1965 nationwide surveys. The data were categorized according to data collected (1960 or 1965) and reason for using recreation facility (vacation or short trip), and separate demand equations were estimated for each category. Separate estimates were also obtained for each category after aggregating the data. Finally, these demand equations were used to project demand for recreational activities to 1970 and 1985. These projections assume, of course, that none of the underlying, structural relationships change during the period considered. To the extent that this assumption is correct, a partial quantitative answer is provided to the question of how much recreational opportunities should be provided by public bodies. These forecasts also demonstrate the feasibility, within an appropriate range, of a policy of reasonable public pricing of recreation services. Such a policy of reimbursement could serve the dual functions of helping to place recreation financing on a user fee basis and reducing excess demand, and the resulting misallocation of resources, resulting from the present zero pricing policy. Numerous tables and appendices contain relevant data and information. (Settle-Wisconsin)
W72-02134

SECONDARY ECONOMIC EFFECTS OF IRRIGATION ON THE COLORADO HIGH PLAINS,
Colorado State Univ., Fort Collins. Dept. of Economics.
D. D. Rohdy, D. B. Tanner, and P. W. Barkley.
Colorado State University, Experiment Station, Fort Collins, Colorado, Bulletin 545S, June, 1971. 25 p, 1 fig, 7 tab, 10 ref, 1 append. OWRR B-007-COLO (6).

Descriptors: *Colorado, *Economic impact, *Irrigation.
Identifiers: *Secondary economic effects, *Income multiplier, *Business multiplier.

A study of Kit Carson County, Colorado, representative of the Colorado High Plains, was conducted to indicate the magnitude of agricultural dominance and economic interrelationships among all sectors of the economy. To measure secondary economic effects of irrigation, all economic units were classified into eleven processing and three payment sectors by the main source of income. The flow of funds data used to calculate the direct purchases required from each sector per dollar of total output by a specific sector was obtained by monitoring cancelled checks for 10 days in 1966 at local banks. Second-round purchases are the secondary economic effects to be calculated. Business and income multipliers were determined from the direct and indirect requirements per dollar output by sectors. These multipliers measure relative importance of the sectors, with the four agricultural sectors having the largest multipliers. For these four sectors the business multipliers ranged from 1.77 to 2.45; the income multipliers ranged from 1.73 to 2.77 (for Type I) and 2.05 to 3.30 (for Type II). From these results the economic impact of continued irrigation development for the Colorado High Plains and for each specific economic sector can be predicted. (Haugh-Wisconsin)
W72-02136

1970 LITERATURE REVIEW, ADMINISTRATION: ECONOMICS,
Rutgers-The State Univ., New Brunswick, N. J.
Water Resources Research Inst.
W. Whipple, Jr.
Journal Water Pollution Control Federation, Vol 43, No 6, p 1370-1376, June, 1971. 60 ref.

Descriptors: *Reviews, *Publications, *Water resources, *Economics, Environmental effects, Water quality, Welfare (Economics), Pollution abatement.

The year 1970 produced an outpouring of publications relating to the economics of water quality. Of these publications, sixty are reviewed. Discussions of economic principles relative to environmental pollution ranged from very broad, general concepts to limited improvements. Among the more general approaches, Rothenberg theorized that congestion and pollution were only different aspects of the same phenomenon, Breslow explained basic pollution economics and listed four corrective approaches to optimization, and Reichart indicated some of the difficulties in the measurement of environmental quality. Among those following a more limited approach, Leontif demonstrated how pollution could be related in a measurable way to some particular consumption or production process and incorporated into input-output analysis. Coale showed that economic factors were more important to the increase in pollution than population growth was, and Stepp studied water pollution loadings resulting from certain South Carolina plants. Also receiving consideration in the 1970 literature were subjects such as pollution situations in foreign countries, regional water quality control, effluent charges on industrial water users, and problems of economic optimization and suboptimization. (Settle-Wisconsin)
W72-02140

WINTER COMMERCE ON THE BALTIC: SOME IMPLICATIONS ON OPENING THE GREAT LAKES,

Michigan State Univ., East Lansing. Graduate School of Business.

J. L. Hazard.

Land Economics, Vol XLVII, No 3, p 256-266, August, 1971. 32 ref.

Descriptors: *Navigation, *Sea ice, *Iced lakes, *Great Lakes, *Economic evaluation, Ice breakup, Fresh water, Lake ice, St. Lawrence Seaway, Technology, Inland waterways.
Identifiers: *Baltic Sea, *Finland, *Winter commerce, Water transportation.

Finnish icebreaking technology on the Baltic is suggested as a possible model for opening the geographically similar Great Lakes to winter commerce. The Finnish government has chosen to keep the Baltic Sea open rather than rely on overland transportation or seasonal stockpiling. The additional icebreaking costs only amount to 12% of winter freight revenues or less than 1.5% OF THE VALUE OF COMMERCE MOVED DURING THE WINTER MONTHS. Recent technical innovations that help keep these costs low include increased icebreaker horsepower (12-38,000 hp), bow air jets for maneuvering, the use of nuclear reactor power, and the development of cargo ships with icebreaking capabilities. As an incentive to more construction of icebreaking cargo ships, the towing rates and ice fees charged decrease with a vessel's icebreaking ability. The U.S. Corps of Engineers estimates that it would cost \$2.7 million to keep the Great Lakes open. The mid-continent has the trade potential to fill the Great Lakes route, but use will have to increase beyond the 16-18% of total trade now using the route. In addition, more research is essential in lake ecology, effects on power and shore property, techniques of channel ice control, traffic control and benefits from winter commerce. (Wade-Wisconsin)
W72-02143

ECONOMIC EVALUATION OF SOME WATERSHED MANAGEMENT ALTERNATIVES ON FOREST LAND IN WEST VIRGINIA,
Forest Service, Columbus, Ohio. Northeastern Forest Experiment Station; and Forest Service, Parsons, West Va. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 04A.
W72-02146

CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS,
For primary bibliographic entry see Field 06E.
W72-02148

HYDROLOGY AND WATER RESOURCES IN ARIZONA AND THE SOUTHWEST, VOLUME I,
American Water Resources Association.
For primary bibliographic entry see Field 04A.
W72-02212

PHYSIOGRAPHIC LIMITATIONS UPON THE USE OF SOUTHWESTERN RIVERS,

Museum of Northern Arizona, Flagstaff.

C. S. Breed.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 367-372, 1971. 5 ref.

Descriptors: *Arizona, *Arid lands, *Colorado River Basin, *Water allocation (Policy), *Groundwater mining, Dams, Evaporation, Overdraft, Colorado River Compact, Water table, Water loss, Water resources development, River flow, River basin development, Geomorphology, Water law.
Identifiers: *Central Arizona Project.

Southwestern rivers are few in numbers and low in discharge. The physiographic and climatic reasons for this are discussed. To the east of the 100th meridian, rainfall is reliable and agriculture is stable; while to the west, there is a chronic deficit of water, droughts are frequent and lifestyles must be accordingly adjusted. Dam building results in greatly increased silting behind the dam in both the river and its tributaries and accelerated channel erosion below the dam. Total flow must also decrease due to withdrawals and increased evaporation from reservoirs. The correction of apparent errors in measuring the virgin flow of the Colorado River now indicates that this flow is about 15 maf/yr. Current legal allocations total 17.5 maf/yr of river water, including the Central Arizona Project (CAP), which will withdraw 1.2 maf/yr. While the river is being dammed and overallocated beyond all reason, the water table is being mined at the alarming rate of 20 ft/yr. In Central Arizona, it has dropped to about 250 ft below the surface, and even if all withdrawals ceased immediately, it would take many centuries of desert rains before it would return to its former level of 50 ft. The CAP water will cancel only about 1/2 of this overdraft annually. A glance at the Phoenix area today shows that rain follows neither the farmers plow nor the subdividers bulldozer. (See also W72-02212) (Casey-Arizona)
W72-02235

USE AND ABUSE OF SOUTHWESTERN RIVERS. HISTORIC MAN-THE ANGLO,

Arizona State Univ., Tempe.

For primary bibliographic entry see Field 04A.
W72-02238

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ECONOMICS AND POLITICS IN WATER POLLUTION CONTROL,
Clemson Univ., S. C.
For primary bibliographic entry see Field 05G.
W72-02135

THERMODYNAMICS OF ENVIRONMENTAL DEGRADATION,
National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center.
For primary bibliographic entry see Field 05G.
W72-02137

Field 06—WATER RESOURCES PLANNING

Group 6C—Cost Allocation, Cost Sharing, Pricing/Repayment

THE DISPOSAL OF AGRICULTURAL WASTE,
For primary bibliographic entry see Field 05E.
W72-02142

COMPARISON OF WATER PRICING STRUCTURES FROM A COLLECTIVE UTILITY VIEWPOINT,

Arizona Univ., Tucson. Dept. of Systems Engineering.

B. Metler, and L. Duckstein.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 327-350, 1971. 2 fig, 6 ref.

Descriptors: *Systems analysis, *Municipal water, *Water conservation, *Economic efficiencies, *Model studies, Groundwater, Arizona, Arid lands, Economic impact, Water demand, Water supply, Water values, Mathematical models, Regressive taxes, Pricing.

Identifiers: *Collective utility.

As a result of continually lowering water tables in the arid regions of the west, many people are beginning to realize that water should be treated like any other rare resource, letting supply and demand factors regulate its distribution. Three types of price structures are used by water agencies: (1) the flat rate system (2) the step rate system and (3) the block rate system. Each of these structures may be progressive or regressive. At present, Tucson's only source of water lies underground and will presumably decrease as the population increases. To optimize the benefits to the community, it may be necessary to decrease not only average consumption but also summertime peak consumption for swimming pools, evaporative coolers and lawn sprinkling. Currently, Tucson uses a regressive block rate pricing structure. Using the theory of collective utility, a model is developed for use in comparing 2 price structures in an effort to define a monetary value for water conservation. It is concluded that the change in collective utility, dU , which is a measure of the worth of change from economic state 1 to 2, is the best measure of price changes in arid areas. The model shows that Tucson water consumption would be lowered and money would be lost with either price structure, but with the permanent change, monetary flow of goods would be greater than under the seasonal structure. (See also W72-02212) (Casey-Arizona) W72-02233

6D. Water Demand

A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS: LANDOWNER PERCEPTION OF RECREATIONIST ASSOCIATED CONFLICTS IN THE SALMON-LITTLE SALMON RIVER CORRIDOR OF IDAHO,
Idaho Univ., Moscow. Dept. of Geography.
For primary bibliographic entry see Field 06B.
W72-01746

WATER QUALITY MANAGEMENT PLANNING IN SOUTH CAROLINA: A PLANNING MANUAL

South Carolina State Planning and Grants Div., Columbia. Community Affairs Section.

Available from the National Technical Information Service as PB-201 431, \$3.00 in paper copy, \$0.95 in microfiche. June 30, 1971. 40 p, 1 fig. HUD No. SCP-43.

Descriptors: *Planning, *Pollution abatement, *Federal project policy, *Cost sharing, *Grants, Programs, Water resources development, Water supply, Water pollution control, Sewers, Financing, Local governments, Sanitary engineering.
Identifiers: *Regional planning.

The manual is designed for use by regional and local planners in the development of water pollution abatement programs and water and sewer plans. It also provides county and municipal officials with general information regarding federal assistance programs and clarifies the relationship of the local planning program to state and regional planning efforts. The manual is divided into two parts. Part I deals exclusively with the programs of Farmers Home Administration, the Department of Housing and Urban Development, and the Environmental Protection Agency. It describes the programs of each, outlines the pertinent planning requirements prerequisite to grant approval, and discusses past application and current status of these programs within the state. Part II sets forth a coordinated planning program designed to meet state, regional, and local planning needs and to satisfy federal planning requirements. Consideration is given to the program elements and to the organizational, administrative and functional aspects of regional planning. (Poertner) W72-01825

PRELIMINARY STUDY OF THE DEVELOPMENT OF WATER RESOURCES OF THE HUMACAO SUB-REGION, PUERTO RICO.

Black and Veatch International, Kansas City, Mo.

Available from the National Technical Information Service as COM-71-00716, \$6.00 in paper copy, \$0.95 in microfiche. Puerto Rico Aqueduct and Sewer Authority, San Juan, Puerto Rico, May 1971. 191 p, 18 fig, 33 tab, 50 ref. Commerce Technical Assistance Project.

Descriptors: *Water supply, *Flood control, *Waste water disposal, *Economic feasibility, Interbasin transfers, Groundwater mining, Surface-groundwater relationships, Levees, Floodways, Forecasting, Channel improvement, Puerto Rico, Water pollution control, Islands, Waste water treatment, Sanitary engineering, Reclamation, Land use, Regional analysis.
Identifiers: *Humacao (PR).

Water supply needs and potential yield from various sources are discussed and analyzed. Surface water and ground water control problems are identified. The Humacao Sub-Region includes three municipalities within its arbitrarily defined boundaries. The Sub-Region receives an average daily rainfall of about 500 million gallons, of which about one-half is lost through evapotranspiration and the balance runs off into the sea in floods during short, intense storms. Alternative recommendations are made on how to provide water for the area's changeover from an agricultural to an industrial economy. These include use of ground water as an economical water source and surface water through reservoirs, wastewater reclamation, and long distance imports. Sea water as a source is reported as uneconomical. Floodways and levees are recommended rather than flood water storage reservoirs for flood control. It is recommended that the present practice of disposing of wastewater into streams be discontinued and replaced by ocean disposal. It is also recommended that data be coordinated for providing guidance in the design of water development projects. Strict regulations are recommended to avoid waste resulting from increasing competition for water supplies. (Poertner) W72-01829

INVENTORY AND PROBLEM DELINEATION, PHASE I REPORT, REGIONAL WATER SUPPLY AND WASTEWATER DISPOSAL STUDY.

Camp, Dresser and McKee, Inc., Boston, Mass.

Piedmont Triad Council of Governments, Greensboro, North Carolina, June 1971. 54 p, 4 fig, 34 tab, 275 ref. HUD North Carolina P-130.

Descriptors: *Water supply, *Waste water disposal, *Municipal water, *Planning, *Regional analysis, Water resources development, Administration, Water resources, Water users, Industrial use, North Carolina.

Identifiers: *Piedmont triad region.

Existing and planned water supply and wastewater disposal systems in the eleven county Piedmont Triad Region are inventoried and discussed. This inventory is the first step in the development of a comprehensive regional plan for water resource utilization in the area. Questionnaires were mailed to cities, counties, sanitary districts, authorities and industry to obtain the information needed from urban areas. Information on rural needs for water supply and wastewater disposal was obtained by questionnaires mailed to members of the North Carolina Grange. An extensive literature review was made of publications pertaining to water resource utilization in the study area. Personal interviews were conducted with city, county and state officials and supervisors of water and wastewater facilities. Public water is supplied to about 65 percent (636,000 persons) of the 5,443 square mile study area. Thirty eight wastewater disposal systems serve 52 percent (509,000 persons). Total public water usage averages about 108 million gallons per day and public wastewater discharge is about 76 mgd. This is expected to increase in coming years. Unless legislation is enacted to permit interbasin water transfer, one or more of the following steps must be taken: (1) develop all practical intra-basin transfers, (2) increase water reclamation and reuse, (3) improve water conservation practices, (4) limit industrial development and population growth. (Poertner) W72-01830

DETERMINING THE DEMAND AND ECONOMIC VALUE FOR THE WATER-BASED OUTDOOR RECREATION RESOURCES AT LAKE MACBRIDE STATE PARK IN THE SUMMER OF 1970,

Iowa Univ., Iowa City. Water Resources Research Inst.

M. G. Glascock, and J. J. Born.

Available from the National Technical Information Service as PB-204 816, \$3.00 in paper copy, \$0.95 in microfiche. Iowa Water Resources Research Institute, Ames. Completion Report ISWRRI-40, 1971. 161 p, 1 fig, 63 tab, 31 ref, 4 append. OWRR B-017-IA (2).

Descriptors: *Water demand, Parks, Surveys, *Use rates, *Recreation demand, Iowa, Recreation facilities, *Lakes, Evaluation, Water utilization, Social needs, Social participation, Water users.
Identifiers: *Lake MacBride State Park (Iowa), Projected demand.

The purpose was to determine how user patterns relate to the economic values of water-based recreation facilities at Lake MacBride State Park. This includes a survey of present demand for existing water-based recreation facilities in the park, determination of socio-economic variables which may partially explain demand, and monetary values placed on water recreation areas and their use by the consumer. Estimates have been made of resultant expanded park use areas and proximity and design of areas and facilities and their potential effect on use patterns. An examination of the sources of water pollution of Lake MacBride was made. In addition, projected levels of pollution were analyzed and recommendations for the alleviation of this problem were made. (Powell-Iowa State) W72-01980

LONG-TERM WATER BALANCE OF THE IRTYSH RIVER IN KAZAKHSTAN (PERSPEKTYVNY VODOKHOZAYSTVENNYY BALANS R. IRTYSHA V KAZAKHSTANSKOGO CHASTI),

Akademija Nauk Kazakhskoi SSR, Alma-Ata.

For primary bibliographic entry see Field 04A.

W72-02066

WATER AND HYDROELECTRIC POWER RESOURCES OF THE UPPER IRTYSH BASIN (VODNYYE I VODNOENERGETICHESKIYE

WATER RESOURCES PLANNING—Field 06

Water Law and Institutions—Group 6E

RESURSY BASSEYNA VERSHNEGO IR-TYSHA,
For primary bibliographic entry see Field 04A.
W72-02067

ON THE ECONOMIC IMPACT OF LARGE DIVERSIONS OF SNAKE RIVER WATERS,
Washington State Univ., Pullman. Water Research Center.
C. B. Millham, and R. A. Russell.
Water Resources Bulletin, Vol. 7, No. 5, p. 925-934, October 1971. 2 fig., 3 tab., 8 ref.

Descriptors: *Pollution abatement, *Diversion losses, *Hydroelectric power, *Dynamic programming, *Economic impact, Optimization, Streamflow, Volume, Columbia River.

Identifiers: *Snake River.

An assessment was made of the economic losses that would be incurred from a number of differing volumes of diversion from the Snake River above Brownlee Dam for a year having the low-flow characteristics of the period May 1928-April 1929. The year was divided into six time periods and mean monthly streamflow data were converted into data involving acre-feet per month. This streamflow was then adjusted for irrigation allocations and return flows. A value per acre-foot of monthly streamflow for power generation for the year 1990 was obtained. Dynamic programming was the method used to find an 'annual value' of the Snake-Columbia complex, using the given data. The streamflow was then reduced above Brownlee by the desired volume of diversion during each time-period and the annual value computed for the diminished flow. Two basic kinds of diversion patterns were considered: 'seasonal' diversion and 'continuous' diversion. Continuous diversion was substantially more expensive than the discontinuous diversion. The results determined the losses due only to pollution abatement and power generation. (Markell-Cornell)
W72-02124

OUTDOOR RECREATION IN NEW YORK STATE: PROJECTIONS OF DEMAND, ECONOMIC VALUE, AND PRICING EFFECTS FOR THE PERIOD 1970-1985,
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 06B.
W72-02134

6E. Water Law and Institutions

WATER QUALITY REQUIREMENTS FOR RECREATIONAL USES,
Public Health Service, Washington, D. C.
For primary bibliographic entry see Field 05G.
W72-01807

STANDARD UTILITIES LOCATION.
Greater Tampa Utility Group, Fla. Standardization Committee.
For primary bibliographic entry see Field 08A.
W72-01821

WATER RESOURCES POLICY IN WISCONSIN: A SUMMARY ASSESSMENT, VOLUME 1,
Wisconsin Univ., Madison. Water Resources Center.
I. K. Fox.

Available from National Technical Information Service as PB-204 928, \$3.00 in paper copy, \$0.95 in microfiche. Partial Completion Report, 1971. 164 p., 4 fig., 1 tab., 20 ref. OWRR B-038-WIS (1).

Descriptors: *Water policy, *Water quality control, Water resources development, *Water supply, *Industrial water, *Interagency cooperation, *Decision making, *Municipal water, Water allocation (Policy), Flood protection, Regions, *Wisconsin, *Institutions, Social participation.

Identifiers: Democratic participation, Information generation, Information utilization, Social efficiency, Rectitude, *Milwaukee (Wisc), Wisconsin River basin.

This report provides a summary of three groups of studies pertaining to water resources management in the state of Wisconsin. One group is an integrated set of studies dealing with institutional design for water quality management in the Wisconsin River basin. The second set deals with metropolitan water resources management, and focuses on the area of southeastern Wisconsin near Milwaukee. The third group consists of miscellaneous studies which have implications for policy and institutional design. The adequacy of existing institutional arrangements are analyzed on the basis of democratic participation, information generation and utilization, social efficiency, liberty, and rectitude. (See also W71-05037 thru W71-05039 and W71-05383, and W72-01486 thru W72-01487) (Uttermann-Wisconsin)
W72-01979

CHARACTERISTICS AND POLLUTION PROBLEMS OF IRRIGATION RETURN FLOW.

Utah State Univ., Foundation, Logan.
For primary bibliographic entry see Field 05B.
W72-01984

VESSEL AND AIRCRAFT GARBAGE.

California Agriculture Code Ann secs 16001 thru 16154 (West 1968).

Descriptors: *California, *Water pollution control, *Waste disposal, *Waste storage, Legislation, Legal aspects, Water law, Water pollution, Water pollution sources, Wastes, Domestic wastes, Ships, Aircraft, Regulations, State governments, Solid wastes, Water quality control.

Any regulations adopted pursuant to this division should not conflict with orders or regulations of the United States Department of Agriculture. Pertinent terms are defined. If there is no approved means of processing garbage aboard a vessel or aircraft, the person in charge of such vessel or aircraft shall provide receptacles with tight-fitting covers in which the garbage may be temporarily retained. It is unlawful to discharge or deposit any garbage into the water or onto land from a vessel or aircraft, with the following exceptions: (1) disposal for immediate burning in incinerators; (2) discharge for approved treatment or disposal; or (3) delivery to a licensed garbage collector. It is unlawful to retain garbage on a vessel or aircraft, except in tightly closed receptacles. It is also unlawful to remove food stores from any vessel, aircraft, or other vehicle without a permit to do so. It is unlawful to aid or abet a violation of this division of the Code. (Johnson-Florida)
W72-02122

DISPOSAL OF REFUSE OR DEAD ANIMALS.

Wyoming Statutes secs 35-462 thru 35-464 (1959).

Descriptors: *Wyoming, *Water pollution, *Waste disposal, *Water quality control, Degradation (Decomposition), Pollution abatement, Water pollution control, Wastes, Industrial wastes, Municipal wastes, Waste dumps, Sawdust, Saw mills, Sewage treatment, Sewage disposal, State governments, Local governments, Legislation, Public health, Legal aspects.

It shall be unlawful to deposit or place refuse matter or dead animals into any watercourse so as to cause pollution. Such actions are hereby declared to be nuisances detrimental to the public health. Certain existing municipal sewage disposal systems are not within the scope of these provisions. The throwing of sawdust from sawmills into any watercourse is also prohibited. Any person violating the provisions of this Act shall be guilty of a misdemeanor. (Smiljanich-Florida)
W72-02123

VALIDATION OF POLITICAL SIMULATION MODELS - WATER RESOURCE PROJECTS, Michigan Univ., Ann Arbor. Dept. of Civil Engineering.

For primary bibliographic entry see Field 06A.
W72-02129

BOSARGE V. STATE (OUTER LIMITS OF ALABAMA'S TERRITORIAL JURISDICTION).

121 So. 427-428 (Ct App Ala 1928).

Descriptors: *Alabama, *State jurisdiction, *Islands, *Commercial fishing, Legislation, Boundaries (Property), Boundary disputes, Shrimp, Brine shrimp, Legal aspects, Judicial decisions, Legislation.

Defendant shrimp fisherman was convicted of violating an Alabama Law prohibiting the taking of shrimp within Alabama's territorial jurisdiction by a person who had not been an Alabama resident for one year. Defendant was apprehended trolling for shrimp about 3/4 of a mile south of Dauphin Island within Mobile Country and the Gulf of Mexico. Alabama boundaries included all islands within six leagues of the shore. Since no other islands lay south of Dauphin Island, and it was within six leagues of the coastline, the Alabama Supreme Court held that the southern coast of Dauphin Island was the southern boundary of Alabama. The court noted a United States Supreme Court decision holding that a state's territorial jurisdiction extended one marine league from its coast. Therefore, the location at which defendant was apprehended was within Alabama's territorial jurisdiction. The conviction was affirmed. (Hart-Florida)
W72-02133

DAMS AND DIKES ACROSS WATERWAYS.

Corps of Engineers, Washington, D. C.

33 Code of Federal Regulations sec. 209.125 (1970). 2 p.

Descriptors: *Damsites, *Dam construction, *Dikes, *Federal Power Act, *Navigable waters, Dams, Dam design, Retaining walls, Shore protection, Administration, Administrative agencies, Administrative decisions, Regulation, Federal government, State governments, Legal aspects, Water law, Navigation, Navigable rivers, Supervisory control (Power), Planning.

An application for approval of the Chief of Engineers and the Secretary of the Army of the location and plans of a dike or dam must be filed with the appropriate District Engineer. The application consists of a letter containing: (1) the name and address of the applicant, (2) the waterway and location of the structure, (3) the legislative authority for the structure, (4) a map of the locations, and (5) plans of the structure showing those features which affect navigation. Dikes or dams may be built under the state legislative authority if the navigable portions of the waterway lie entirely within state limits. Otherwise, an Act of Congress is necessary. Applications for authority to construct water power dams and transmission lines over navigable waters are subject to the Federal Power Act. The letter of application must be signed by the owner, proprietor, or a duly authorized agent. Specifications are detailed for: (1) plan requirements, (2) drawing sizes, (3) drawing titles, (4) location maps, and (5) special instructions. (Johnson-Florida)
W72-02138

POLLUTION CONTROL ACT.

South Carolina Code Ann. secs. 63-195 thru 63-195.36 (Supp. 1970).

Descriptors: *South Carolina, *Water pollution control, *Water quality control, *Regulation, Administrative agencies, Sewage, Industrial wastes, Waste treatment, Waste disposal, Treatment facilities, Air pollution, Public health, Permits, In-

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

vestigations, Inspection, Adjudication procedure, Judicial decisions, Interstate compacts, Federal government, Grants, Classification, Pollution abatement, Standards.

The policy of South Carolina is to maintain water and air quality standards consistent with public health, safety, and welfare; maximum employment; industrial development; and the propagation and protection of fauna and flora. A Pollution Control Authority is created within the State Department of Health, and its membership is described. Its powers include the following: (1) holding hearings, (2) making and revoking orders, (3) instituting legal proceedings, (4) issuing and denying permits for waste discharges, (5) conducting studies and investigations, (6) developing a comprehensive control and abatement program, (7) accepting and distributing grants, and (8) managing programs under the Federal Water Pollution Control Act. Considerations for establishing a classification system and setting water and air quality standards are detailed. Standards may prescribe the extent of permissible floating and suspended solids and bacteriological organisms and other physical, chemical, biological properties. Permits for waste discharges and the construction of waste disposal systems are required. Means to correct undesirable pollution levels are detailed. The necessity for public hearings and their conduct are set forth. Provision is made for appeals. The duties of the Attorney General to prosecute are outlined. Violations of the Act constitute misdemeanors. (Rees-Florida) W72-02139

A BILL TO AMEND THE FEDERAL WATER POLLUTION CONTROL ACT TO PROVIDE FINANCIAL ASSISTANCE FOR RIVER BASIN PROGRAMS.

House Bill 7398, 92d Cong, 1st Sess, 1971. 4 p.

Descriptors: *River basin development, *Government finance, *Administrative agencies, *Water quality control, Federal government, Grants, Costs, Water pollution control, Pollution abatement, Standards, Training, Operation and maintenance, Inspection, Investigations, Treatment facilities, Diversion, Impoundments, Waste treatment, Legislation, Jurisdiction.

Section 7 of the Federal Water Pollution Control Act is amended by the addition of a new subsection under which the Secretary of the Interior is authorized to make grants to intrastate basin water quality management agencies having water quality jurisdiction consistent with applicable statutes of the state concerned. These grants are not to exceed 50% of the administrative, investigatory, operator training and water quality control inspection costs of any management plan. Each such plan must be consistent with applicable water quality standards and must be approved by appropriate state agencies before a grant may be made. A basin water quality management plan shall provide for comprehensive water quality control, such as: (1) control of wastes; (2) construction, operation, and maintenance of waste treatment facilities; (3) control of flow, diversion, or impoundment of basin water; and (4) techniques for financing and distributing the costs of waste treatment facilities. Grants shall not exceed three years but can be renewed. Agencies receiving subsection (k) grants are ineligible for grants under other provisions of section 7. Basin means an entire river, stream or their tributaries, coastal waters, estuaries, lakes and related land resources that form appropriate hydrological units for water quality management purposes. (Rees-Florida) W72-02141

WATER RESOURCES.

Kentucky Rev. Stat. secs. 151.100 thru 151.990 (1966).

Descriptors: *Kentucky, *Legislation, *Water resources, *Water management (Applied), Water

resources development, Water conservation, Water policy, Water pollution, Permits, Administrative decisions, Administrative agencies, Water supply, Water utilization, State governments, Federal government, Planning, Legal aspects, Financing, Government finance, Dams, Levees.

Kentucky has enacted comprehensive legislation to promote proper utilization of its water resources in the public interest. A Division of Water is created to administer the statutes. The Act defines public waters, and requires permits for the withdrawal of public waters, with some exceptions. Water withdrawn under permit must be reported quarterly. Notice and hearing are required before permit denial; if a permit is granted, it must be specific concerning such factors as time, amount, and location. A permit does not vest an absolute right in the holder. Judicial review of orders is available. Notwithstanding permits, water may be temporarily allocated among users. The Division of Water is directed to conduct water resources studies. Permits are required for dams or levees, and judicial review of permit denials is available. Division of Water personnel are authorized to enter public and private lands for inspections. Any deposits into waters without a permit are prohibited. A Water Resources Authority is created to contract with the federal government and coordinate state agencies in water conservation and usage. The Authority may also condemn land and issue revenue bonds to finance projects. Comprehensive financing provisions are set forth. (Hart-Florida) W72-02144

PUBLIC UTILITIES—WATER AUTHORITIES.

Public Act 76-2446, Illinois Legislative Service, p 573-574 (1970), amending, Illinois Annotated Statutes Ch 111 2/3, sec 228.

Descriptors: *Water districts, *Illinois, *Public utility districts, *Wells, *Water supply, Taxes, Administrative agencies, Regulation, Permits, Financing, Legal aspects, Water resources, Water delivery, Legislation, Local governments, Supervisory control (Power).

An Illinois Public Act concerning the establishment of water authorities and the definition of their powers and duties is amended to provide that the board of trustees may: (1) inspect wells and other withdrawal facilities, and require the submission of data from the operator; (2) require the registration of wells; (3) require permits for additional wells, or for deepening or enlarging existing wells; (4) require the plugging of abandoned wells or the repair of wells to prevent water loss or contamination; (5) regulate water use reasonably during a period of drought; (6) supplement existing water supplies by practical and feasible means, including acquisition of property rights by purchase or condemnation; (7) sell water; (8) levy and collect a general tax on the taxable property within the limits of the authority; (9) consult with and receive information concerning the duties and responsibilities of state administrative agencies; (10) sue to restrain violation or threatened violation of rules, regulations or ordinances; and (11) provide by ordinance that violation of adopted regulations, rules, or ordinances shall constitute a misdemeanor punishable by a \$50 fine. (Hart-Florida) W72-02145

CONCEPTS USED AS ECONOMIC CRITERIA FOR A SYSTEM OF WATER RIGHTS.

S. V. Ciriacy-Wantrap.
In: Economic and Public Policy in Water Resource Development, Iowa State University Press, Ames, p 251-271, 1970, 21 p, 33 ref.

Descriptors: *Economics, *Water allocation (Policy), *Preference (Water rights), *Water resources development, Economic impact, Economic efficiency, Economic justification, Investment, Risks, Water law, Water supply, Water policy, Water rights, Prescriptive rights, Prior appropriation, Riparian rights, Legal aspects, Competing uses,

Water resources, Water requirements, Water users, Water utilization.

Dealing with economic concepts as criteria for a water rights system, this article discusses the following factors: (1) economic criteria in and for water law, (2) security of water rights interpretation, (3) security of water rights and investment protection, (4) flexibility of water rights interpretation, (5) welfare economics and water allocation, and (6) economic criteria and the public interest. Water quality and quantity are closely related in determining water rights. Economics can explain why and how far certain conditions influenced by the law affect the national income. Moreover, conflicts can frequently be identified in economic terms before they become legal controversies; after they have become legal controversies the essential economic features may no longer be clear. To understand the relationship of the two disciplines one must have an understanding of concepts used as economic criteria in water law: the security and flexibility of water rights. The strengthening of the relations between economics and the law will benefit both disciplines. (Robinson-Florida) W72-02148

LIMITATION ON DIVERSION FROM THE WATERSHED: RIPARIAN ROADBLOCK TO BENEFICIAL USE.

C. E. Hill.
South Carolina Law Review, Vol 23, No 1, p 43-62, 1971. 20 p, 78 ref.

Descriptors: *Watersheds (Basins), *South Carolina, *Riparian waters, *Water transfer, *Inter-basin transfers, Water rights, Riparian rights, State governments, Federal government, Water law, Legal aspects, Water users, Water supply, Water resources, Water resources development, Water utilization, River basins, Prior appropriation, Permits.

Water diverted from a watercourse must be retained in the watershed. Generally, riparian land is that portion of a tract held in a single title contiguous to the watercourse and within the watershed. Under the traditional riparian doctrine stream water may only be used on riparian land. The riparian system protects the interests of those in the watershed, but in the West where water is scarce many states use the prior appropriation system. Numerous state systems are herein discussed. States can prevent waters of a wholly intrastate stream from being exported to another state, but the federal government has the right to transport the waters of interstate or intrastate navigable streams. In reference to South Carolina's situation, the author maintains that there is no reason for the watershed limitation: groundwater aquifers cause interbasin transfers. There should also be a comparison of intrabasin benefits with the benefits to be gained from diversion. A balancing of interests approach would be the best for all interests. In a state with a comprehensive water plan and competent administrative machinery there is no need for any restrictions on interbasin transfers. (Robinson-Florida) W72-02149

THE RIGHTS OF THE PUBLIC VERSUS THE RIGHTS OF RIPARIAN OWNERS TO THE USE OF THE SHORE BETWEEN THE WATER'S EDGE AND THE HIGH WATER MARK ON LAKE MURRAY.

A. L. Harman.
South Carolina Law Review, Vol 23, No 1, p 71-81, 1971. 11 p, 22 ref.

Descriptors: *South Carolina, *Riparian land, *Lake shores, *Littoral, *Public rights, Lakes, Riparian rights, Banks, Legal aspects, Water law, Land tenure, Navigable waters, Ownership of beds, Riparian waters, Shores, Judicial decisions, Lake beds, Real property, Relative rights.

The conditions which large have from edge not of a non-public high owner ever, water title to the water riparian high value of the between (Robin-Florida) W72-02149

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WATER RESOURCES PLANNING—Field 06

Water Law and Institutions—Group 6E

The case law of South Carolina and other jurisdictions is evaluated in this article to determine whether the riparian owners of Lake Murray, a large man-made navigable lake in South Carolina, have the right to exclude members of the public from entering on the shore between the water's edge and the high water mark. South Carolina does not own the bed and banks of the lake because it is a nontidal body of water. Cases have held that the public does not have the right to enter below the high water mark when that strip of land is privately owned. When title to the bed is in the state, however, the public may use the shore below the high water mark. The issue seems to turn upon who has title to the land between the high water mark and the water's edge. The author concludes that the riparian owners, both those who hold title to the high water mark and those who hold title to the bed of the lake, have the exclusive right to use the shore between the water's edge and the high water mark. (Robinson-Florida) W72-02150

A WELTER OF IDEAS—A MODICUM OF COORDINATION,
Du Pont de Nemours (E.I.) and Co., Delaware, Md.
For primary bibliographic entry see Field 05G.
W72-02151

ORSANCO—1970.
For primary bibliographic entry see Field 05G.
W72-02152

COASTAL ZONE MANAGEMENT—THE TIDE-LANDS: LEGISLATIVE APATHY VS. JUDICIAL CONCERN,
T. J. Barrack, V. Shue, R. T. Theep, and L. E. Weiss.
San Diego Law Review, Vol 8, No 3, p 695-733, May 1971. 39 p, 206 ref.

Descriptors: *Coasts, *Beds, *Permits, *Judicial decisions, Legislation, California, Florida, Beds under water, Ownership of beds, Legal aspects, Estuaries, Public rights, Public lands, Public benefits, Management, Tidal waters, Submerged Lands Act, Tidal marshes.
Identifiers: *Constitutionality.

Effective tidelands management has been inhibited by the multiplicity of entities exercising control over them. Three recent judicial decisions demonstrate the conflicts arising from these multiple influences. In *City of Long Beach v. Mansell* California had legislatively disclaimed interest in tidelands on Alamitos Bay, and the city and state had contracted to convey the tidelands to private parties. The state constitution, however, prohibited alienation of public trust lands, and the city's agents refused to perform. The California Supreme Court held that either the constitution was not violated or the city was estopped from asserting it. In another case, *Candlestick Properties* owned submerged land on San Francisco Bay, but its dredge and fill permit had been denied. *Candlestick Properties, Inc. v. San Francisco Bay Commission* held that denial of the fill permit was a reasonable exercise of the police power and not an inverse condemnation. Similarly in *Zabel v. Tabb* the Corps of Engineers denied a dredge permit solely on ecological grounds. The United States Fifth Circuit Court upheld the denial. The difficulty which these courts encountered in resolving conflicting statutes, constitutions, and common law doctrines demonstrates the necessity for comprehensive federal legislation for coastal zone management. (Hart-Florida) W72-02153

NATIONAL WATER QUALITY STANDARDS ACT OF 1971.
For primary bibliographic entry see Field 05G.
W72-02154

INDUSTRY/GOVERNMENT TELECONFERENCE ON POLLUTION CONTROL.
For primary bibliographic entry see Field 05G.
W72-02155

WHAT CONSTITUTES NATURAL DRAINWAY OR WATERCOURSE FOR FLOW OF SURFACE WATER.

American Law Reports, Annotated, Vol 81, p 262-274, 1932. 9 p.

Descriptors: *Watercourses (Legal), *Easements, *Riddance (Legal aspects), *Surface drainage, *Judicial decisions, Drainage, Surface waters, Drainage systems, Repulsion (Legal aspects), Runoff, Surface runoff, Ditches, Streams, Roads, Kansas, Illinois, Minnesota, Legal aspects, United States.

Irrespective of whether a lower estate is subject to a drainage servitude for surface water or whether surface water is a 'common enemy,' a lower owner may not obstruct the flow of surface water in a well-defined channel or depression. Similarly, the upper owner may collect surface water on his land and discharge it into a natural channel or depression. Cases relating to the requisite characteristics of such channels or drainways are the subject of this annotation. The terminology used to describe a drainway varies, but the primary consideration of the annotation is its physical characteristics. Drainways sufficiently defined to attract the attention of a casual observer are generally permitted for surface water drainage. Use of the depression for the cultivation of crops will not necessarily render it insufficient to support a drainage servitude. If a drain spreads out to an undefined area, a servitude may also be permitted. The annotation discusses Kansas, Minnesota, Illinois, and federal decisions in the area. Furthermore, it notes that artificial ditches may create a servitude, although some states require the depression to be a ravine or gorge. The use of streets and gutters as drainways is also discussed. (Hart-Florida) W72-02156

PERIODICAL, SEASONAL, OR INTERMITTENT STREAM AS A WATERCOURSE.
American Law Reports, Annotated, Vol 40, p 839-854, 1926. 16 p.

Descriptors: *Watercourses (Legal), *Intermittent streams, *Non-perennial streams, *Ephemeral streams, Surface waters, Rivers, Storm runoff, Drainage systems, Surface drainage, Water spreading, Canals, Channels, Grassed waterways, Drainage water, Overland flow, Rain water, Judicial decisions, Legal aspects.

Without considering the legal incidents or consequences of the characterization of streams as 'watercourses', this annotation considers whether a periodical, seasonal, or intermittent stream is a 'watercourse'. Generally, to constitute a watercourse, a stream need not flow continually, but may be dry at times if it has a well-defined substantial existence. It must have at least a dependable, regular flow at certain seasons. The annotation examines holdings in various states to support and give examples of this general rule. A watercourse is more than surface drainage occasioned by the unusual flow from a flood or freshet. Overflow water from a river or stream is not generally regarded as surface water, and it is therefore part of the watercourse. Nevertheless, the rule that gullies, ravines, swales, sloughs, and similar depressions do not constitute watercourses prevails, although there is a conflicting authority. For example, a swale for the collection of rain water with a fixed and continuous course has been held to be a watercourse. Sloughs have also been held to be watercourses. (Hart-Florida) W72-02157

REQUIREMENT FOR THE CAPPING OF CERTAIN ARTESIAN WELLS.
General Act No 516, Georgia Laws, p 669-671 (1969). 3 p.

Descriptors: *Georgia, *Artesian wells, *Flow control, *Well regulations, Wells, Groundwater, Well spacing, Flow, Natural flow, Discharge (Water), Obstruction to flow, Flow rates, Water control, Water supply, Land tenure, Regulation, State governments, Local governments, Swimming pools, Livestock, Legislation, Legal aspects.

The owner or immediate supervisor of any real property in the state on which any free flowing artesian well is located shall have such artesian well capped or otherwise capped, except when in use, when the flow of the well is greater than one inch in diameter and the well is within one-half mile of any other free flowing well. If the artesian wells are located on government property, the expenses involved shall be borne by the state agency or the political subdivision owning such real property. Penalties are prescribed for violations of the Act. The Act shall not apply to free flowing wells in constant use for the purpose of watering and cooling livestock, or which supply any public swimming pool. (Smiljanich-Florida) W72-02186

HILL CITY COMPRESS CO. V. WEST KENTUCKY COAL CO. (COMMON BOUNDARY OF LOUISIANA AND MISSISSIPPI).
122 So. 747-749 (Miss. 1929).

Descriptors: *Mississippi, *Louisiana, *Mississippi River, *Boundary disputes, *Land tenure, Thalweg, Navigable rivers, State jurisdiction, Avulsion, Bank erosion, Real property, Canals, Relative rights, Rivers, Judicial decisions, Legal aspects.

Plaintiff riparian landowner sought to force defendant coal company to pay rent to plaintiff for tying up barges on the canal bank to which plaintiff asserted ownership. Defendant asserted that the land was in Louisiana and owned by defendant's lessor through adverse possession. The Mississippi River changed its channel by avulsion in 1876, but the boundary between Mississippi and Louisiana was unaltered by the avulsion. The thread of the stream lay east of the disputed canal bank prior to the avulsion, but the center of the stream was west of the canal. Therefore plaintiff contended the center of the stream rather than the thread determined the state boundary. Defendant asserted a converse proposition. Following a decision of the United States Supreme Court, the Supreme Court of Mississippi held that the thread of the stream was the common state boundary. The court affirmed the lower court's decision for defendant on grounds that the chancellor's finding of fact should not be disturbed. (Hart-Florida) W72-02195

STATE V. JOHNSON (BOUNDARY OF LAND BOUNDED BY AN INLET WHICH CLOSED BY ACCRETION).
179 S.E.2d 371-388 (N.C. 1971). 18 p.

Descriptors: *North Carolina, *Condemnation, *Accretion (Legal aspects), *Boundary disputes, Land tenure, Real property, Boundaries (Property), Bank erosion, Eminent domain, Compensation, State governments, Administrative agencies, Water law, Judicial decisions, Legal aspects, Inlets (Waterways).

Plaintiff state sought to condemn lands purportedly belonging to defendant landowner for use as a public historic site. Although defendant contended that plaintiff had not satisfied statutory requirements for condemnation proceedings, his assertion was summarily rejected by the trial court. Defendant also contended that he owned the disputed lands, rather than other parties to the action, and asserted that registration of the disputed lands under the Torrens system was invalid by in-

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

adequate publication of notice. Defendants owned land south of the land sought for condemnation; the northern boundary of defendant's tract was originally an inlet. However, the inlet closed by accretion, and defendants and the contiguous owner to the north sought to fix their common boundary by new conveyances. The disputed lands would belong to defendants under the boundary thus fixed by reciprocal deeds. In affirming the trial court, however, the Supreme Court of North Carolina determined that the common boundary was fixed by the closing of the inlet, and the deeds did not affect the boundary of the lands being condemned. Accretions do not alter a boundary unless a body of water is the boundary. Since an easement claimed in the disputed lands by defendant was not recorded in the Torrens deeds, the court held that defendants had no interest in the condemned lands. (Hart-Florida)
W72-02201

6F. Nonstructural Alternatives

A TENTATIVE CLASSIFICATION OF MEADOWS IN THE FLOODPLAINS OF THE MSTA RIVER (IN RUSSIAN), Leningrad State Univ. (USSR).

Y. I. Samoilov.
Identifiers: Classification, Floodplains, Formula, Group, Index, Meadows, Msta, River, USSR.

The problems associated with distinguishing the initial taxa (associations) by means of the analysis of interspecific association with the use of the 2 x 2 table are discussed. After having grouped the species according to their mutual occurrence in a community, it is suggested to estimate the importance of each species-group in this community by means of the group index, i.e., the sum of covers of the species belonging to the same group present in the community, divided by the total number of the representatives of this group. Such a taxon as the formation is abandoned and the following hierachic scheme is proposed: association-group of associations-class of association-subtype of meadow vegetation-type of vegetation.—Copyright 1971, Biological Abstracts, Inc.
W72-01976

6G. Ecologic Impact of Water Development

ENHANCEMENT OF ECOLOGIC AND AESTHETIC VALUES OF WATER ASSOCIATED WITH INTERSTATE HIGHWAYS, Massachusetts Univ., Amherst.

For primary bibliographic entry see Field 04C.
W72-01698

NAVIGATION PROJECT, NEWARK BAY, HACKENSACK AND PASSAIC RIVERS, NEW JERSEY, (FINAL ENVIRONMENTAL STATEMENT).

Army Engineer District, New York.
For primary bibliographic entry see Field 08A.
W72-01826

'S STREET CHANNEL IMPROVEMENTS, NEEDLES, SAN BERNARDINO COUNTY, CALIFORNIA, ENVIRONMENTAL STATEMENT (ENVIRONMENTAL STATEMENT).

Army Engineer District, Los Angeles, Calif.
For primary bibliographic entry see Field 08A.
W72-01828

NATURAL RESOURCE CONSERVATION: AN ECOLOGICAL APPROACH,

Oliver S. Owen.
Macmillan, New York, N.Y. 1971. 593 p., Illus.
\$9.95.
Identifiers: Book, Conservation, Deer, Ecological, History, Human, Natural, Resource, Waterfowl, Wildlife.

This volume contains an introduction to the conservation of natural resources for students in departments of life science, geography, forestry or economics. The objectives are to acquaint the student with characteristics and values of natural resources, to show that the environmental crisis that besets America today is a scientific reality, to explain basic ecological concepts and their significance and to provide a knowledge of the techniques and policies by which resources can be effectively managed and used. Written from the ecological point of view, the text emphasizes the interrelationships between resources. Discussed are: the nature of resources, the history of the conservation movement, the urgency of the movement and basic concepts of ecology and their relationship to modern conservation technique. Using this ecological background the following topics are considered: soils, water, grasslands, forest, wildlife, waterfowl, deer, freshwater fisheries, marine resources, atmosphere, pesticides and human populations. Also presented is extensive material on living resources, the atmosphere and pesticides. The informal and integrated presentation, the bibliographies and the illustrations make this text accessible to a wide range of non-specialists.—Copyright 1971, Biological Abstracts, Inc.
W72-01896

COMPLEX-USE MANAGEMENT OF WATER RESOURCES OF THE OB RIVER BASIN (KOMPЛЕКСНОЕ ОСВОЕНИЕ ВОДНЫХ РЕСУРСОВ ОБСКОГО БАССЕЙНА).

Institut Gidrodinamiki, Novosibirsk (USSR).
For primary bibliographic entry see Field 04A.
W72-02061

NATURAL MOISTURE CONDITIONS OF THE OB BASIN AND PROSPECTS OF WATER DEVELOPMENT (VESTESTVVENNYYE USLOVIYA UVLAZHENIYA TERRITORII OB-SKOGO BASSEYNA I PERSPEKTYV GIDROMELIORATSII),

Omskii Selskokhozyaistvennyi Institut (USSR).
For primary bibliographic entry see Field 04A.
W72-02063

FISH MANAGEMENT IN THE OB RIVER BASIN IN THE LIGHT OF POSSIBLE CONSTRUCTION OF THE LOWER OB HYDROELECTRIC POWER PLANT (RYBNOYE KHOZYAYSTVO OBUKOGO BASSEYNA PRI USLOVII SOZDANIYA NIZHNE-OBUKHOVSKOGO),

For primary bibliographic entry see Field 04A.
W72-02064

PRESENT-DAY AND LONG-TERM WATER AND SALT BALANCE OF SOUTHERN SEAS OF THE USSR (AZOV, CASPIAN AND ARAL) AND POSSIBLE CHANGES IN THEIR HYDROLOGIC AND HYDROCHEMICAL REGIMES (SOVREMENNYI I PERSPEKTYVNYE VODNYI I SOLEVOV BALANSY I VOZMOZHNNYYE IZMENENIYA GIDROLOGICHESKOGO I GIDROKhimICHESKOGO REZHIMOV YUZHNYKH MOREY SSSR (AZOVSKOGO, KASPIYSKOGO I ARAL'SKOGO),

State Oceanographic Inst., Moscow (USSR).
For primary bibliographic entry see Field 02H.
W72-02099

EMPIRICAL STUDY OF ECONOMIC-ECOLOGIC LINKAGES IN A COASTAL AREA,

Clemson Univ., S.C. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 06A.
W72-02126

NITROGEN SUPERSATURATION IN THE COLUMBIA AND SNAKE RIVERS,

Environmental Protection Agency, Seattle, Wash.
Region X.
For primary bibliographic entry see Field 05B.
W72-02159

SUMMARY REPORT, NITROGEN SUPERSATURATION IN THE COLUMBIA AND SNAKE RIVERS,

Environmental Protection Agency, Seattle, Wash.
Region X.
For primary bibliographic entry see Field 05B.
W72-02160

IS THE CANARY DYING: THE TIME HAS COME FOR MAN, MINER OF THE WORLDS RESOURCES TO SURFACE,

C. R. Goldman.
Calif Med. 113 (5): 1970. 21-26.
Identifiers: Air, Brown, Canary, Carbons, Chlorinated, Dying, Ecological, Falcon, Hydro, Imbalance, Lead, Man, Mercury, Miner, Nuclides, Oil, Pelican, Peregrine, Radio, Resources, Surface, Time, Words.
W72-02250

ECOLOGICAL HEALTH AND QUALITY OF LIFE, NOW AND FOREVERMORE,

M. S. W. Watts.
Calif Med. 113 (5): 1970. 55-57.
Identifiers: Atmosphere, Care, Contaminated, Ecological, Health, Human, Land, Life.
W72-02252

07. RESOURCES DATA

7A. Network Design

NEW APPROACH TO HYDROLOGIC DATA ACQUISITION,

National Inst. of Scientific Research, Quebec.
E. J. Langham.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY 12, Paper 8578, p 1965-1978, December 1971. 13 ref, append.

Descriptors: *Data collections, *Telemetry, *Data storage and retrieval, *Data processing, Rainfall-runoff relationships, Storm runoff, Data transmission, Instrumentation, Hydrologic data, Model studies, Mathematical models, Computers.

A transition is taking place in the acquisition of hydrologic data from networks of recording instruments to various systems based on modern electronic telemetry techniques. The criteria for any specification of source data have to be derived from the purpose of the data. One of these purposes may be to provide a system description and boundary conditions for a mathematical model. A new format is presented and analyzed. A prototype data acquisition system based on these principles was set up in a small urban catchment. The study area is only 13 acres and is the closed surface drainage system associated with a freeway underpass. The principal objective of the investigation was to construct a model relating rainfall, runoff, and sewer flow for storms. The rainfall is measured by tipping-bucket rain-gages which measure 0.01 inch at a time. The highest spatial frequency of rainfall intensity variations which persists for 2 min provides the necessary criterion of spatial resolution for precipitation data. Data are obtained also from flow-measuring weirs, full-flow turbine meters in the pump station, and a water-level recorder in the pumphouse well. All signals are brought to a computer on landlines. (Knapp-UGS)

W72-02018

INFLUENCES OF EXPOSURE ON PAN EVAPORATION IN A MOUNTAINOUS AREA,

Utah Water Research Lab., Logan; and Environmental Science Services Administration, Rockville, Md.
For primary bibliographic entry see Field 02D.
W72-02119

7B.

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RESOURCES DATA—Field 07

Data Acquisition—Group 7B

7B. Data Acquisition

URANIUM AND TRITIUM AS NATURAL TRACERS IN THE FLORIDAN AQUIFER,
Florida State Univ., Tallahassee. Dept. of Geology.
For primary bibliographic entry see Field 04B.
W72-01696

A METHOD OF MONITORING MUDFLOW MOVEMENTS,
Queen's Univ., Belfast (Ireland). Dept. of Geography.
For primary bibliographic entry see Field 02J.
W72-01722

A PRACTICAL EVALUATION OF THE CLARKE-BUMPUS PLANKTON SAMPLER AND SUGGESTIONS FOR ITS USE,
Minnesota Univ. Water Resources Research Center.
For primary bibliographic entry see Field 05C.
W72-01735

DESIGN AND CONSTRUCTION OF A SHALLOW WATER SEDIMENT CORE SAMPLER,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05A.
W72-01738

A NEW BORE-HOLE INCLINOMETER,
California Inst. of Tech., Pasadena.
For primary bibliographic entry see Field 02C.
W72-02001

AN IMPROVED METHOD FOR DETERMINING ICE FABRICS,
Wisconsin Univ., Milwaukee. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02C.
W72-02002

CHEMICAL INTEGRATING THERMOMETER FOR WATER TEMPERATURE MEASUREMENT,
Environmental Data Service, Silver Spring, Md. Lab. for Environmental Data Research.
For primary bibliographic entry see Field 02K.
W72-02013

OCEAN SPECTRA FOR THE HIGH-FREQUENCY WAVES AS DETERMINED FROM AIRBORNE RADAR MEASUREMENTS,
Naval Research Lab., Washington, D. C.
G. R. Valenzuela, M. B. Laing, and J. C. Daley.
Journal of Marine Research, Vol 29, No 2, p 69-84, May 15, 1971. 7 fig, 7 tab, 24 ref.

Descriptors: *Ocean waves, *Radar, *Remote sensing, Waves (Water), Surveys, Instrumentation.

Ocean spectra for short gravity and gravity-capillary waves were derived from radar cross-section measurements of vertical polarization at 428 MHz, 1228 MHz, 4455 MHz, and 8910 MHz. The average power law of the ocean spectra for these high wave numbers and for strong winds is -3.721 , which is in reasonable agreement with observations on the behavior of the spectrum in the equilibrium range. Exponential growth of gravity-capillary waves was observed with light winds, using the wind dependence of the radar cross-section data; with strong winds, the wind dependence of the radar cross section is in agreement with the -3.721 power law of the spectra. (Knapp-USGS)
W72-02014

DETECTION OF THAWING SNOW AND ICE PACKS THROUGH THE COMBINED USE OF VISIBLE AND NEAR-INFRARED MEASUREMENTS FROM EARTH SATELLITES,
National Environmental Satellite Service, Washington, D. C.
A. E. Strong, E. P. McClain, and D. F. McGinnis.
Monthly Weather Review, Vol 99, No 11, p 828-830, November 1971.

Descriptors: *Remote sensing, *Satellites (Artificial), *Snowpacks, *Snowmelt, Aerial photography, Surveys, Melting, Albedo, Infrared radiation.

Melting snow or ice may be detected using multispectral remote sensing from earth satellites. Snow and thick ice are highly reflective in both the visible and the near-infrared portions of the electromagnetic spectrum. During thaw conditions, however, near-infrared radiation is absorbed strongly, while reflection of visible radiation is only slightly affected. Simultaneous visible and near-infrared imagery from the Nimbus 3 satellite illustrates how these reflectance differences can be used to obtain useful information. (Knapp-USGS)
W72-02016

MICROWAVE RADIOMETRIC DETECTION OF OIL SLICKS,
Aerojet-General Corp., El Monte, Calif. Microwave Div.
For primary bibliographic entry see Field 05A.
W72-02024

A SYSTEM ANALYSIS OF APPLICATIONS OF EARTH ORBITAL SPACE TECHNOLOGY TO SELECTED CASES IN WATER MANAGEMENT AND AGRICULTURE-VOLUME 1, TECHNICAL SUMMARY.
Planning Research Corp., Washington, D. C.

Available from the National Technical Information Service, Springfield, Va., 22151, as N71-28444. \$3.00 in paper copy, 50.95 in microfiche. Planning Research Corporation Report PRCR-1224 (Revised November 1969). 51 p, 38 fig, 8 ref. (NASA CR-119010).

Descriptors: *Water resources development, *Water management (Applied), *Remote sensing, *Telemetry, *Systems analysis, Hydrologic data, Data collections, Water users, Irrigation, Flood control, Navigation, Recreations, Agriculture, Model studies, Evaluation, Costs.
Identifiers: *NASA.

A concept for employing multispectral remote sensors onboard spacecraft as a part of an information system to assist in management of specific water resource and agricultural activities is proposed and evaluated. The Technology required is either available or expected to be available by the mid 1970's. The system concept relates all components and subsystems to decisions and actions which concern the managers and users of the information which could be provided, even though the system has not been optimized with respect to equipment and configuration. The specific applications studied were (1) water management of the Columbia River Basin to increase benefits from hydropower generation, irrigation, flood control, navigation, and recreation; (2) management of wheat crop yield and inventory control for the United States, considering worldwide wheat demand and production; and (3) early detection and control of wheat rust fungi to increase the wheat yield in the United States. The system concept includes four satellites, each carrying three remote sensors along with appropriate equipment for attitude control, data storage, and telemetry. A multispectral scanner, a multispectral television, and a multiband radar are used for remote sensing of earth phenomena. The ground components comprise five data receiving sites that will forward data to a centralized location for processing and information analysis. (Woodard-USGS)
W72-02029

A BIAXIAL PROPELLER CURRENT-METER SYSTEM FOR FIXED-MOUNT APPLICATIONS,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.

G. A. Cannon, and D. W. Pritchard.
Journal of Marine Research, Vol 29, No 2, p 181-190, May 15, 1971. 6 fig, 2 tab, 4 ref. ONR Contract Nonr 4010 (11) and Nonr 477 (37).

Descriptors: *Current meters, *Instrumentation, Calibrations, Estuaries, Oceanography, Waves (Water), Currents (Water), Ocean waves, Ocean currents.

A biaxial propeller current-meter system for use in shallow water, where instrumentation can be attached to rigid bottom-mounted towers, was developed at the Chesapeake Bay Institute. The use of two like sensors to measure the horizontal-velocity vector eliminates the problem of matching time constants in rotor-vane systems. The propellers have a noncosine response to the angle of attack of the flow. However, the data recorded by two propellers mounted at right angles are sufficient to correct for the noncosine response. (Knapp-USGS)
W72-02038

A STABLE SPAR-BUOY PLATFORM FOR MOUNTING INSTRUMENTATION,
Naval Underwater Systems Center, Newport, R. I. D. H. Shonting, and A. H. Barrett.
Journal of Marine Research, Vol 29, No 2, p 191-196, May 15, 1971. 2 fig, 1 tab, 6 ref.

Descriptors: *Equipment, *Instrumentation, *Oceanography, Surveys, Data collections.
Identifiers: *Spar buoys, *Oceanographic instruments.

A simple relatively portable, and inexpensive spar buoy was constructed to provide a platform for supporting instrumentation above and below the ocean's free surface. The buoy is 18.9 m long and weighs 76 k in air; the combined ballast and instrument payload weigh 65 kg. The buoy consists of buoyant sections that are easily dismantled and may be varied in number to alter the buoy's overall length, draft, and payload. When the buoy is coupled to a damping disc at its base, it has a natural period of heave in excess of 30 seconds and can be used in the presence of surface waves averaging a period of 7 seconds and up to 2.0 m in height. (Knapp-USGS)
W72-02039

INFLUENCES OF EXPOSURE ON PAN EVAPORATION IN A MOUNTAINOUS AREA,
Utah Water Research Lab., Logan; and Environmental Science Services Administration, Rockville, Md.
For primary bibliographic entry see Field 02D.
W72-02119

OPTICAL FOURIER TRANSFORM TECHNIQUE FOR MEASURING SEDIMENT CONCENTRATION,
Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
For primary bibliographic entry see Field 02J.
W72-02158

TREE-RING DATING OF COLORADO RIVER DRIFTWOOD IN THE GRAND CANYON,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.

C. W. Ferguson.
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings, Arizona Section-American Water Resources Association and the Hydrology Section-Arizona Academy of Science, April 22-23, 1971, Tempe, Vol 1, p 351-366, 1971. 2 fig, 2 tab, 11 ref.

Descriptors: *Dendrochronology, *Bristlecone pine trees, *Radiocarbon dating, History, Water

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

level fluctuations, Pinyon pine trees, Arizona, *Driftwood. Identifiers: *Tree-ring chronology, *Archaeological studies.

The development of tree-ring chronology for bristlecone pine (*Pinus aristata*), stretching over 8,200 years, has been used to calibrate the radiocarbon time scale. An extensive deposit of driftwood in Stanton's Cave in the Grand Canyon was estimated to have been deposited on the cave floor about 12,000 years ago on the basis of the 4,095-year radiocarbon age of a split-twig figurine on the surface of the cave floor. However, the initial driftwood specimen gave the surprising C-14 age of 35,000 years. A tree-ring dating study was therefore undertaken on driftwood in the Grand Canyon in order to: (1) evaluate the driftwood deposit in Stanton's Cave; (2) provide a basis for interpreting C-14 dates from canyon archaeological sites; and (3) document a technique for deriving some concept of pre-dam hydrology, especially maximum high water levels. The percentage of dated specimens found indicated that the approach was feasible. A likely interpretation of the seemingly early C-14 dates at archaeological sites is that prehistoric man used old driftwood, as does modern man in the canyon. Tree-ring dates from wood above the pre-dam high water mark indicate that maximum 100-year flood evidence can be obtained. (See also W72-02212) (Casey-Arizona) W72-02234

7C. Evaluation, Processing and Publication

STATISTICAL INFERENCE ON STREAMFLOW PROCESSES WITH MARKOVIAN CHARACTERISTICS,
Arizona Univ., Tucson. Dept. of Mathematics.
For primary bibliographic entry see Field 02E.
W72-01704

FINITE-DIFFERENCE CONVECTION ERRORS,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.

David A. Bella, and William J. Grenney.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA 6, December 1970, p 1361-1375. 9 fig, 2 tab, 6 ref. EPA Program 16070 DGO.

Descriptors: *Numerical analysis, *Mathematical models, *Convection, Water circulation, Mass transfer, Dispersion, Data processing, Analytical techniques.

Identifiers: Finite-difference convection approximation, *Oscillation errors, *Distribution spreading errors, *Skewness errors, Slug load.

The errors associated with the use of several commonly used finite-difference convection approximations have often escaped notice, possibly contributing to the misinterpretation of model results. For simplicity, only one-dimensional convection (downstream movement) was investigated. Errors were investigated by constructing a slug load of 100, concentrated within a single cell. The nature of the errors revealed from these investigations allowed classification of them into three categories. In the first category, oscillations in the numerically computed distributions were found. These oscillations resulted from removal of more material from a cell over a time interval than is present in that cell at the beginning of the time interval. The second category of errors is characterized by the skewness of the numerical distribution. This error was defined by the magnitude of the skewness as computed by (Normalized third movement about centroid)/(variance) (3/2). Spreading of the distribution categorized the third category of errors, expressed by a pseudo dispersion coefficient given by $D_p = 1/2$ (rate change in variance) — 1/2 (2nd derivative dy/dt). Numerical methods were developed classifying each error, demonstrating that the errors could be calculated and controlled. (Lowry-Texas)

W72-01858

NEW APPROACH TO HYDROLOGIC DATA ACQUISITION,
National Inst. of Scientific Research, Quebec.
For primary bibliographic entry see Field 07A.
W72-02018

DETERMINATION OF NONLINEAR FUNCTIONAL RESPONSE FUNCTIONS IN RAINFALL-RUNOFF PROCESSES,
California Univ., Davis. Dept. of Water Science.
For primary bibliographic entry see Field 02A.
W72-02116

DIGITAL SIMULATION OF AN EXISTING WATER RESOURCES SYSTEM,
Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 06A.
W72-02132

UNCERTAINTIES IN DIGITAL-COMPUTER MODELING OF GROUNDWATER BASINS,
Geological Survey, Tucson, Ariz.; and Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 02F.
W72-02215

08. ENGINEERING WORKS

8A. Structures

STANDARD UTILITIES LOCATION.
Greater Tampa Utility Group, Fla. Standardization Committee.

February 14, 1968. 30 p, 14 fig.

Descriptors: *Public utilities, *Locating, *Sewers, *Water distribution (Applied), *Distribution systems, *Right-of-way, Public utility districts, Road design, Sanitary engineering, Drainage engineering, Planning, Underground structures, Urbanization, Coordination, Florida, Design standards.

Identifiers: *Tampa (Fla), *Standard utility locations.

A pattern is proposed for standardization for the location of utilities with the public right-of-way of proposed street or highway improvements in the Greater Tampa Area. Standard right-of-way cross-sections were submitted by the various utility companies showing their preferences for locating utility lines and facilities, above ground and below ground, in the various typical standard-width streets. Fourteen different locational diagrams are included showing the agreed-upon locations of each utility type, measured horizontally from the curb or property line. Water and sewer lines are included. These standards are for the general guidance of the various utility companies and do not constitute absolute requirements. It is recognized that present trends and future requirements concerning individual underground communication systems and structures may impose a necessary change and/or alteration to these standards. At the present time there is no official agency in existence to coordinate the planning and location of all utilities that require public rights of way and easements for their locations. It is recommended that these standards be submitted to the Director of Hillsborough County Planning Commission for review and possible adoption within the framework of Subdivision Control Standards for the Hillsborough County. It is anticipated that the Planning Commission will recommend the adoption of these standards to the three cities involved and to the Hillsborough County Engineering Department. (Poertner) W72-01821

MINIMUM DESIGN STANDARDS FOR COMMUNITY WATER SUPPLY SYSTEMS (EXISTING STANDARD-FHA 4517.1) (DRAFT ENVIRONMENTAL STATEMENT).

Department of Housing and Urban Development, Washington, D.C. Assistant Secretary for Housing Production and Mortgage Credit.
For primary bibliographic entry see Field 05F.
W72-01822

NAVIGATION PROJECT, NEWARK BAY, HACKENSACK AND PASSAIC RIVERS, NEW JERSEY, (FINAL ENVIRONMENTAL STATEMENT).
Army Engineer District, New York.

Available from the National Technical Information Service as PB-199 973F, \$3.00 in paper copy, \$0.95 in microfiche. April 30, 1971. 43 p, 15 fig.

Descriptors: *Planning, *Environmental engineering, *Navigable rivers, *Environmental effects, *Channel improvement, New Jersey, Odor, Impaired water quality, Turbidity, Dredging, Water quality control, Pollution control, Sea water, Rivers, Bays.

Identifiers: *Passaic River, *Hackensack River, *Newark Bay, *Environmental statement.

The navigation project involves widening the existing 35-foot channel, widening and deepening the existing 32-foot channel, deepening the 12-foot channel, and establishment of maneuvering areas. The project is located in New Jersey. The widening will result in reduction of tanker and barge accidents by enhancing the general navigation safety features of the waterway and also will provide for the efficient and safe shipment and receipt of waterborne commodities, thereby alleviating the potential of a serious oil spill. Comments on the environmental statement were submitted to the Corps of Engineers by the following agencies: Tri-State Transportation Commission; Bergen County Planning Board; Passaic County Planning; Tri-State Staff; Middlesex County Planning Board; Dept. of Planning-Economic Development-Conservation, Essex County; Union County Planning Board. Comments were made concerning oil spills, disposal of dredgings, and associated environmental and ecological damage that may result. The Corps listed temporary turbidity and odors during dredging operations and brief water quality degradation during dumping operations as the only adverse environmental effects. (Poertner) W72-01826

EFFECTS OF TEMPORARY AND PERMANENT BLANKETS ON TIDES AND CURRENTS IN EAST RIVER, HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experimentation Station, Vicksburg, Miss.

W. H. Bobb, and T. C. Hill.
Available from the National Technical Information Service as AD-724 539, \$3.00 in paper copy, \$0.95 in microfiche. Miscellaneous Paper H-69-7, April 1969. 70 p, 55 fig, 2 tab.

Descriptors: *Tunnel construction, *Tunnel design, *Tunneling, *Underground structures, Underwater, Subsurface investigations, New York, Transportation, Blowouts, Construction.

Identifiers: *New York City, *East River, *Subways, Compressed air shields, Rapid transit.

A tunnel is discussed that the New York Transit Authority plans to construct under the East River between Manhattan and Long Island. Either the open-trench or compressed-air shield method will be used. For the compressed air shield method, a temporary protection blanket would be required to prevent possible blowout during construction, and after construction is completed, a permanent blanket will be required to provide protection for the tunnel. The existing comprehensive fixed-bed model of New York Harbor was used to determine the effects of both permanent and temporary blankets in the west channel of the East River on exist-

ENGINEERING WORKS—Field 08

Hydraulics—Group 8B

ing hydraulic conditions. Model tests were conducted to determine the effects of both permanent and temporary blankets at various elevations. The following general conclusions appear valid on the basis of the model test results reported herein. The blanket tested would have no major effect on tide heights. The permanent blanket with a top elevation of 45 ft msl caused no noticeable change at any of the tide stations at which measurements were obtained. The temporary blankets caused slight increases in the plane of low water upstream of the proposed fills. With both temporary blankets installed, navigation in the west channel could be adversely affected, because of both the magnitude of the currents and the restriction in width of the channel. (Poertner)

W72-01827

'S' STREET CHANNEL IMPROVEMENTS, NEEDLES, SAN BERNARDINO COUNTY, CALIFORNIA, ENVIRONMENTAL STATEMENT (ENVIRONMENTAL STATEMENT).

Army Engineer District, Los Angeles, Calif.

Available from the National Technical Information Service as PB-200 547F, \$3.00 in paper copy, \$0.95 in microfiche. June 30, 1971. 31 p, 12 fig.

Descriptors: *Planning, *Environmental engineering, *Erosion control, *Flood control, *Environmental effects, Wildlife habitats, Groundwater recharge, Floodways, Diversion, California, Water control.

Identifiers: *Environmental statement, *Impact statement, Siltation control, San Bernardino County (Calif).

This environmental statement covering 'S' Street Channel Improvements, Needles, California, was submitted by the Los Angeles District of the U. S. Corps of Engineers in compliance with Public Law 91-190, the National Environmental Policy Act of 1969. This statement contains a discussion of environmental features and an evaluation of the impact of the recommended project on the environment. The proposed project is authorized under Section 205 of the Flood Control Act of 1948 as amended. The benefit-cost ratio is 2.9 to 1. The purpose of the project is to provide protection to residential, commercial and public properties, including supporting public improvements such as parks and streets, against floods and debris deposition. The recommended improvement will consist of a concrete channel and associated diversion structures to carry floodflows safely to the Colorado River through a portion of the City of Needles. Comments on the Corps' impact statement are included in the report. The agencies that submitted comments were: EPA, HUD, U. S. Bureau of Mines, National Park Service, U. S. Bureau of Sport Fisheries and Wildlife, the Resources Agency of California, and the San Bernardino County Flood Control District. These agencies commented on impacts on ground water recharge, wildlife disturbances, and flood plain management. The Corps' original environmental statement was modified in light of these comments. (Poertner)

W72-01828

JACKING A SEWER UNDER AN INTERSTATE HIGHWAY.

For primary bibliographic entry see Field 05D.

W72-01856

SEWERAGE PRACTICE IN THE GULF COAST AREA,

Tulane Univ., New Orleans, La.

For primary bibliographic entry see Field 05D.

W72-01861

COMPLEX-USE MANAGEMENT OF WATER RESOURCES OF THE OB RIVER BASIN (KOMPЛЕКСНОЕ ИСПОЛЬЗОВАНИЕ ВОДНЫХ РЕСУРСОВ ОБСКОГО БАССЕЙНА).

Institut Gidrodinamiki, Novosibirsk (USSR).

For primary bibliographic entry see Field 04A.

W72-02061

COMPLEX-USE MANAGEMENT OF WATER RESOURCES OF THE OB RIVER BASIN (KOMPЛЕКСНОЕ ИСПОЛЬЗОВАНИЕ ВОДНЫХ РЕСУРСОВ БАССЕЙНА Р. ОБИ),
All-Union Designing, Surveying, and Scientific Research Inst. Hydropotekhnika, Moscow (USSR). For primary bibliographic entry see Field 04A.

W72-02062

HYDROLOGIC EFFECTS OF WATER CONTROL AND MANAGEMENT OF SOUTHEASTERN FLORIDA,

Geological Survey, Tallahassee, Fla.

For primary bibliographic entry see Field 04A.

W72-02090

HYDROLOGIC COMPUTATIONAL METHODS FOR MARINE HYDRAULIC ENGINEERING CONSTRUCTION (МЕТОДЫ МОРСКИХ ГИДРОЛОГИЧЕСКИХ РАСЧЕТОВ ДЛЯ СТРОИТЕЛЬСТВА),
State Oceanographic Inst., Moscow (USSR). For primary bibliographic entry see Field 02L.

W72-02094

DAMS AND DIKES ACROSS WATERWAYS.

Corps of Engineers, Washington, D. C.

For primary bibliographic entry see Field 06E.

W72-02138

8B. Hydraulics

DISCONTINUITIES IN STRATIFIED FLOWS,

Waterloopkundig Laboratorium, Delft (Netherlands).

For primary bibliographic entry see Field 02E.

W72-01723

DETERMINATION OF THE LOOP DISCHARGE RATING CURVE FOR FLOOD WAVE PROPAGATION,

Bulgarian Academy of Sciences, Sofia. Inst. for Hydrology and Meteorology.

For primary bibliographic entry see Field 02E.

W72-01724

TIDAL CHOKING,

Utah Univ., Salt Lake City. Dept. of Civil Engineering.

For primary bibliographic entry see Field 02L.

W72-01725

TRANSIENT MOTIONS INDUCED BY LOCAL DISTURBANCES IN A LINEARLY DENSITY-STRATIFIED FLUID,

Tetra Tech. Inc., Pasadena, Calif.

For primary bibliographic entry see Field 02E.

W72-01726

LINEAR PROPORTIONAL WEIRS WITH TRAPEZOIDAL BOTTOMS,

Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.

N. S. Lakshmana Rao, and C. H. Abdul Bhukari.

Journal of Hydraulic Research, Vol 9, No 3, p 413-

427, 1971. 13 fig, 1 tab, 6 ref.

Descriptors: *Weirs, *Discharge measurement, *Stream gages, *Discharge coefficients, *Stage-discharge relations, Hydraulics, Discharge (Water), Streamflow.

Identifiers: Linear proportional weirs.

A proportional weir is a weir with a profile such that the discharge is a desired function of head. Most linear proportional weirs have rectangular bottoms. A difficulty sometimes encountered in

design is that the base width of such weirs tends to infinity. This difficulty can be overcome by a rectangular or trapezoidal bottom, and the datum line above which the head over the weir is measured is placed at some fraction of the height of the rectangular portion above the crest. A general method is proposed for selection of the datum line. Experiments were conducted on a number of different weirs which were cut from 1/2 inch thick mild steel plates. The coefficient of discharge decreases with head, with a decreasing tendency at low heads, often reaching a minimum value and then increasing. (Knapp-USGS)

W72-01728

SHAPES OF GRIT CHAMBERS TO ACHIEVE CERTAIN VELOCITY-HEAD RELATIONS WITH GIVEN SHAPES OF OUTLET WEIRS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
N. S. Rao Lakshmana, and D. Chandrasekaran.
Journal of Hydraulic Research, Vol 9, No 3, p 429-446, 1971. 4 fig, 2 tab, 5 ref.

Descriptors: *Settling basins, *Weirs, *Outlets, Discharge (Water), Hydraulics, Stage-discharge relations, Streamflow, Desilting, Sedimentation.

Identifiers: Linear proportional weirs.

Grit chambers and settling basins may be designed for achieving three mean velocity-head relations, namely: the mean velocity being constant equal to the non-scouring velocity of the sediment particles; the mean velocity varying inversely with head; and the mean velocity decreasing linearly with head. These velocity-head relations can be achieved with outlet weirs such as the rectangular, the parabolic and the triangular types, the Sutro weir, the Stevens proportional weir, and the compound weir made up of two or more of these. The problem of maintaining constant velocities in trapezoidal sections of the grit chambers is analyzed. It is more advantageous to use a trapezoidal-section basin with a compound weir than a rectangular-section basin with a modified Sutro weir. (Knapp-USGS)

W72-01729

DRAG FORCES ON BAFFLE BLOCKS IN HYDRAULIC JUMPS,

Texas A and M Univ., College Station.

D. R. Basco, and J. R. Adams.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY12, Paper 8599, p 2023-2035, December 1971. 9 fig, 1 tab, 14 ref, append.

Descriptors: *Hydraulic jump, *Stilling basins, *Energy dissipation, *Hydraulic structures, *Baffles, Hydraulics, Hydrodynamics, Open channel flow, Loads (Forces), Attenuation.

Identifiers: Baffles (Hydraulic).

Large bluff-shaped objects (baffle blocks) improve hydraulic jump performance characteristics. Knowledge of the drag force on the blocks aids in determining the optimum block geometry. The highly turbulent and nonuniform flow in the jump prevents a theoretical solution to the problem. An experimental technique similar to that employed by aerodynamicists was used to directly measure the drag forces. Block location, height, width, spacing, second-row location, and shape were the geometrical variables investigated. The study was limited to nonsubmerged jumps in wide, rectangular, horizontal channels. A drag force ratio using the free jump, sequent depth pressure force was more practical for data correlation than a classical drag coefficient. Resultant downstream water depths computed using the measured drag force compared favorably with experimentally measured values. The results enable the designer to calculate the drag force for a wide range of block geometries and jump inlet Froude numbers from 3 to 10. (Knapp-USGS)

W72-02019

Field 08—ENGINEERING WORKS

Group 8B—Hydraulics

HYDRAULIC JUMP ASSISTED BY CROSS-JET,
Kentucky Univ., Lexington, Dept. of Civil Engineering.

T.-Y. Kao.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No Hy12, Paper 8614, p 2037-2050, December 1971. 12 fig, 1 tab, 7 ref, append.

Descriptors: *Hydraulic jump, *Jets, *Energy dissipation, *Stilling basins, Turbulent flow, Open channel flow, Hydraulic structures, Attenuation.

A new method of controlling a hydraulic jump uses submerged cross-jet, instead of solid chute blocks and baffle piers, to furrow and lift the supercritical approaching flow. A hydraulic jump is produced which requires smaller tailwater depth and provides greater energy dissipation. The analytical analysis of the characteristics of the jet-forced hydraulic jump is based on the basic momentum and continuity principles and the conservation of energy. The results are verified experimentally. In the case where the jet flow is provided by the same source which provides the approaching flow, better control of the jump is expected. (Knapp-USGS) W72-02060

A UNIFORM FLOW FORMULA FOR FLUMES AND CANALS,

Mississippi State Univ., State College.

B. P. Verma, and J. C. McWhorter.

American Society of Agricultural Engineers Transactions, Vol 14, No 2, p 225-228, 231, 1971. 4 fig, 3 tab, 7 ref. OWRR A-024-MISS (3).

Descriptors: *Uniform flow, *Flumes, *Canals, *Equations, *Analytical techniques, Model studies, Laboratory tests, Mathematical studies, Steady flow, Forecasting.

A dimensional analysis was made for the common case of uniform, turbulent flow, and uniform flow data were obtained by a laboratory flume experiment. An analysis of the data established a uniform-flow formula. The flow equation expresses a relationship for uniform, turbulent flow of water in flumes and canals. The equation is dimensionally homogeneous and does not include ambiguous constants or coefficients. The variables which affect fluid motion are of the following three categories: (a) the several linear dimensions fully defining the geometrical boundary conditions, (b) the kinetic and dynamic characteristics of flow, and (c) the fluid properties. The fluid properties of viscosity and surface tension were not considered pertinent in this study. The effects of roughness and shape factor were not considered in the dimensional analysis of the problem. These effects are included in a dimensionless coefficient. In the uniform flow of fluids, bed slope and energy slope are equal, therefore, the energy slope was dropped from the list of pertinent variables. (Woodard-USGS) W72-02051

SEDIMENT TRANSPORTATION MECHANICS: FUNDAMENTALS OF SEDIMENT TRANSPORTATION.

American Society of Civil Engineers, New York, Task Committee on Preparation of Sedimentation Manual.

For primary bibliographic entry see Field 02J. W72-02059

DYNAMIC FLUID LOSS DURING VISCOS FLUID THROUGH A POROUS VERTICAL SLOT,

Howard Univ., Washington, D.C. Dept. of Chemical Engineering.

P. B. Deshpande, and R. E. Babcock.

Water Resources Bulletin, Vol 7, No 5, p 1002-1007, October 1971. 4 fig, 1 tab, 5 ref.

Descriptors: *Viscous flow, *Flow, *Porous media, Viscosity, Reynolds number, Hydraulic models, Laboratory tests, Porosity, Permeability, Hydraulics, Filtration.

An experimental study was made of two-dimensional viscous flow through a vertical slot with one highly resistive porous wall. The experimental data can be correlated in terms of the difference between the static flow rate and the dynamic fluid loss rate as a function of the bulk Reynolds number and the bulk flow rate. An empirical correlation was developed between the superficial entrance width and the ratio of bulk Reynolds number based on flow through the porous wall. The static flow rate may be considered as an upper limit approached by dynamic fluid loss. An increase in viscous forces increases dynamic fluid loss, due to the increased shear stress created at the surface of the porous wall. Dynamic fluid loss decreases proportional to the one-half power of velocity. (Knapp-USGS) W72-02060

8C. Hydraulic Machinery

A DECADE OF EHV TRANSMISSION IN THE SOVIET UNION—AN ANNOTATED BIBLIOGRAPHY,

Bureau of Reclamation, Denver, Colo.

A. W. Sands.

Bureau of Reclamation, Engineering and Research Center, Denver, Colorado 80225, Bibliography No 248 - Price \$15.50. July 1971. 901 p, 1 map, 2,210 ref.

Descriptors: *Foreign design practices, Foreign construction, Foreign projects, *Bibliographies, *Extra high voltage, *Extra long distance, *Transmission (Electrical), Transmission lines, Direct current, *Tuned transmission, Electric networks, Electrical equipment, Powerplants, Switchyards (Electrical), Substations (Electrical), Electrical stability.

Identifiers: USSR, Liapunov theorem, Unified Power System, USSR.

This annotated bibliography contains 2,210 references to books, monographs, pamphlets, and articles, largely from Soviet sources, on extrahigh-voltage (EHV) transmission for the decade of the Sixties. In 1960, the Soviet Union ranked below the United States and most of Western Europe in power production and consumption. During this period, an intense effort went into design and construction of powerplants, transmission lines, substations, and receiving systems. By 1970, the Soviet Union was second to the United States in production and consumption of electrical energy. This decade is of particular interest because during this period the USSR developed EHV and extra-long-distance bulk transmission instead of the 220- and 330-kv networks used in Western countries. Reports on design problems, construction, and operating experience are referenced. The bibliography is divided into 7 sections: General; A-C Transmission and Associated Equipment; D-C Transmission and Associated Equipment; Tuned Transmission and Associated Equipment; Extra-Long-Distance Transmission, Power Systems; and Research, Computer Studies, and Methodology. The bibliography contains a map of the USSR, a list of the publications referenced, a list of abbreviations, and an index to the numbered references. (USBR) W72-01766

PUMPED STORAGE: STATE-OF-THE-ART.

Proceedings, American Society of Civil Engineers, Journal of the Power Division, Vol 97, No PO3, p 675-695, July 1971. 21 p, 5 fig, 1 ref, append, disc.

Descriptors: *Pumped storage, Electric power production, Reliability, Project planning, Performance, *Hydroelectric power, *Pump turbines, Peak power, *Reversible turbines, Trashracks, *Reviews, Specific speed, Rock mechanics, Generator-motors, Drawdown, Reservoirs, Vibration, Peaking capacities, Spinning reserve.

Dissemination of information concerning the planning, design, and subsequent performance of power projects is necessary for future improvement and refinement. The hydroelectric aspects of power production from pumped storage development are discussed to provide a basis for improved planning. Sites for conventional hydro projects are not as available as they have been in the past, and generally any review of potential hydro development includes some consideration of the use of pumped storage facilities. The concept of using large pumping equipment to produce a head of energy for later use in conventional hydro units is not new. The use of pumped storage has now been expanded to include not only a short-time power capability but the ability to provide emergency service for longer periods. Such developments can be significant in providing reliability in an electric power system. Reliability of electric power is essential, and in some power systems pumped storage projects can be important in achieving it. The present state-of-the-art of pumped storage facilities and some of the problems connected with planning, developing, and operating such systems are discussed by panelists with many years experience in this type facility. (USBR) W72-01771

A STUDY OF REINSERTION TRANSIENT VOLTAGES FOR SERIES CAPACITORS ON USBR GLEN CANYON - FLAGSTAFF 345 KV LINES,

Bureau of Reclamation, Denver, Colo.

L. W. Lloyd.

Pap, Institution of Electrical and Electronics Engineers Summer Meeting, International Symposium on High Power Testing, Portland, Oreg. July 1971. 8 p, 6 fig, 3 tab, 4 ref.

Descriptors: *Transmission lines, *Protection (Electrical), Damping, Spark gaps, *Overvoltage, Substations (Electrical), Electric current, Electrical stability, Electrical impedance, Reactance, Ground currents, Transmission (Electrical), Extra high voltage, Electrical faults, Field tests.

Identifiers: *Series capacitors, Pinnacle Peak Substation, Ariz, *Acacom, *Overcurrent, Glen Canyon Powerplant.

Reinsertion of series capacitors into a transmission line following clearing of bypass current through their protective devices or gaps, like other system switching operations, produces transient voltages within the transmission system and across the series capacitors. The voltage-breakdown setting of the gaps should be higher than the resulting transient voltages across the capacitors to prevent subsequent recurring protective gap sparkover and capacitor bypass. A high setting will increase capacitor duty and investment in equipment. Such transient voltages should be known to set the protective gaps properly and to size the capacitor bank. A technique is presented for investigating the voltage and current transients produced by a series capacitor reinsertion into a transmission line using the transient system analyzer (Anacom). The method and significant results of the Anacom Study made in 1969 simulating series capacitor reinsertion on the Bureau of Reclamation Glen Canyon-Pinnacle Peak 345-kv lines are discussed. (USBR) W72-01775

TOWARD COMPUTER CONTROL OF WASTE-WATER TREATMENT,

Philadelphia Water Dept., Pa.; and General Electric Co., Philadelphia, Pa.

For primary bibliographic entry see Field 05D.

W72-01824

WATER AND HYDROELECTRIC POWER RESOURCES OF THE UPPER IRTYSH BASIN (VODNOYE I VODNOENERGETICHESKIYE RESURSY BASSEYNA VERKHNEGO IRTYSHA),

For primary bibliographic entry see Field 04A. W72-02067

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ENGINEERING WORKS—Field 08

Materials—Group 8G

8D. Soil Mechanics

ROCKFILL.
Building Research Station, Watford (England).

A. D. M. Penman.

CP 15/71, Bldg Research Station, Dept. of the Environment, Symposium on Rock Mechanics and Highway Construction, Newcastle, Gt Brit, Apr 1971. 10 p, 6 fig, 3 tab, 26 ref.

Descriptors: *Embankments, *Embankment subsidence, *Rock fills, Wet condition, *Rockfill dams, Rock mechanics, Rock properties, Construction materials, Construction methods, *Settlement (Structural), Compaction, Gravels, Compressibility, Compressive strength, Compression tests, Shear resistance, Overburden, Pressure, Crushing, Bibliographies, *Roads.

Identifiers: Rock slope, Sluicing, Dry condition, Crushing strength.

The concept of rockfill has changed considerably in the past decade. Before the availability of heavy compacting machinery, loose dumped rockfill was used to build embankments and dams. Settlement was a problem in those structures. To improve the behavior of rockfill, only sound hard rock was used, and fines, which increase settlement by preventing rock-to-rock contact, were kept to a minimum by sluicing; settlement still occurred. Many tests on rockfill have been made in the past few years. These tests showed that settlement caused by loading and wetting can be minimized by limiting interangular forces and preventing the rock particles from moving into a denser packing. This can be done by grading the sizes of rock so that there is a minimum of voids and a maximum of interparticle contacts. The particles must be packed together initially to minimize subsequent rearrangement under load. This approach, combined with increasing size and power of compacting machinery, and the economic advantage of using quarry run material, has led to the use of compacted rockfill for major embankments. Post-construction settlement and rockfills for road embankments are discussed. Has 26 references. (USBR)

W72-01765

W72-01765

DEFORMATION MODULI DETERMINED BY JOINT-SHEAR INDEX AND SHEAR CATALOG.
Bureau of Reclamation, Denver, Colo.
J. L. Von Thun, and G. S. Tarbox.
Rock Mechanics Symposium Paper, Nancy, France, Oct 1971. 13 p, 3 fig, 1 tab.

Descriptors: Rock mechanics, *Deformation modulus, *Rock foundations, Geology, Joints (Geology), Faults (Geology), Shear cracks, Evaluation, In situ rock, Fractures (Geology), Finite element method, Foundations, In situ tests, Jacking tests, Foundation investigations, Design, Arch dams, *Dam foundations, *Research and development.

Identifiers: *Joint-Shear Index, *Shear catalog.

Auburn Dam will be a double-curvature thin concrete arch structure 685 feet high with a crest length of 4000 ft. The dam foundation is characterized by numerous joints, shears, talc seams, and faults of interspersed in a high strength, high modulus rock. The heterogeneity of the foundation required development of methods for evaluating deformation moduli throughout the foundation, including effects of minor discontinuities in a rock mass. The effects of joints, breaks along cleavage, and shears were quantified, and their frequency and distribution were used to determine the rock deformation modulus. The primary method used was the Joint-Shear Index giving a numerical value to each discontinuity according to type, condition, and location. The index is the sum of the values of all weighted discontinuities observed in the core taken from an instrumentation hole. The ratio of in situ deformation modulus to elastic core modulus correlated excellently with the Joint-Shear Index. This correlation enabled prediction of the reduction in modulus at any drill hole location over the entire length of hole. The use and merits of tunnel logging and fracturing indices for determining deformation moduli are discussed. A technique called the Shear Catalog was developed which includes effects of discontinuous shears. (USBR)

W72-01769

8G. Materials

SYNTHETIC RUBBER CANAL LINING, LABORATORY AND FIELD INVESTIGATIONS OF SYNTHETIC RUBBER SHEETING FOR CANAL LINING - OPEN AND CLOSED CONDUIT SYSTEMS PROGRAM,
Bureau of Reclamation, Denver, Colo.
M. E. Hickey.

Available from the National Technical Information Service as PB-200 553, \$3.00 in paper copy, \$0.95 in microfiche. Bureau of Reclamation Report No REC-ERC-71-22, Apr 1971. 34 p, 24 fig, 20 tab, append.

Descriptors: *Adhesives, *Buried membranes, *Canal linings, Field investigations, *Elastomers, Flexible linings, Impervious linings, Laboratory tests, Reservoirs, *Synthetic rubber, Canal seepage, Water conservation, Polymers, Physical properties, Specifications, Subgrade, Bonding tests, Cutoffs, Nylon, Reinforcement.

Identifiers: Butyl rubber, Rubber sheeting.

Accelerated laboratory tests and field performance evaluations indicate that butyl and ethylene propylene diene monomer (EPDM) rubber sheeting can be used satisfactorily as buried membrane and exposed lining for canals and reservoirs. For successful use as exposed lining, service conditions must be such that the rubber lining is protected from mechanical damage and vandalism. Butyl and EPDM rubber sheetings are suitable for relining old concrete canals and reservoirs. Special attention must be given to adequately bonding and anchoring the rubber liner to the concrete in canals where flowing water acts upon the lining. The butyl and EPDM linings are available with or without nylon reinforcement in thicknesses ranging from 20 to 125 mils (0.51 to 3.18 mm), and are adaptable to a variety of waterproofing applications. The type and thickness of lining are dictated by the size of installation and service requirements. The relatively high cost of these linings limits their use to special applications where the use of less costly membrane materials is not possible because of severe operational conditions. (USBR)

W72-01763

8F. Concrete

SULFURIC ACID ATTACK ON CONCRETE SEWER PIPE,
Texas A and M Univ., College Station.

Alvin H. Meyer, and William B. Ledbetter.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No. SA 5, October 1970, p 1167-1182. 9 fig, 1 tab, 23 ref.

Descriptors: *Concrete pipes, *Acidity, *Corrosion, Sulfur bacteria, Acid bacteria, Hydrogen sulfide, Sulfates, Oxidation, Laboratory tests, Deterioration, Sewerage.

Identifiers: *Sulfuric acid, *Etching, Acid dilution.

Laboratory tests were conducted in an effort to uncover a compound or substance which would increase the resistance of portland cement concrete to attack by sulfuric acid. Preliminary tests resulted in the selection of 4 compounds being selected for more intensive investigations. These investigations revealed that the four, magnesium silicofluoride, sodium silicate, potassium silicate, and sodium alginic, did not increase the resistance of the concrete to sulfuric acid attack. In addition, weak sulfuric acid (1%) solutions caused deterioration of both treated and untreated mortars. Acid dilution in sewer pipes may therefore extend their working life, but will not prevent their eventual failure. Varying the contents of the mortar produced from either type I or type II cement failed also in preventing failure, but optimum conditions could result in extended useful life. Attempts are continuing with different chemicals and different applications to produce acid resistant coatings or aggregates, but none of the coatings or methods investigated here were successful. (Lowry-Texas)

W72-01770

FIELD EVALUATION OF HEAVY-WALLED PRESSURE VESSELS USING ACOUSTIC EMISSION ANALYSIS,

Idaho Nuclear Corp., Idaho Falls.

E. V. Waite, and D. L. Parry.

Materials Evaluation, Vol 29, No 6, p 117-124, June 1971. 8 p, 10 fig, 3 ref.

Descriptors: *Nondestructive tests, Acoustics, *Pressure vessels, Tests, *Materials tests, Metals, Stress, *Cracks, *Fractures, *Stress waves, Nuclear reactors, Transducers, Piezoelectric transducers, Computer applications.

Identifiers: *Acoustic emission analysis.

A portable acoustic analysis system has been developed which detects, locates, and analyzes microacoustic energy emissions originating from flaws or cracks within a stressed structure. The system was developed as a nondestructive test technique for the safety assessment of pressure retention envelopes of nuclear power reactors. To aid in the development and evaluation of the acoustic system, acoustic emission data were obtained and on-site analyses made of the integrity of several large industrial chemical reactor pressure vessels in conjunction with the hydrostatic acceptance testing of the vessels. The system was shown to be capable of detecting and locating acoustic emission sites (flaws) as small as 0.1 in. in size with an acoustic signal transmission distance of 60 ft from the emission site to the detector. (USBR)

W72-01776

SURVEY OF APPLICATIONS OF EPOXY RESINS FOR DILV WORKS PROJECTS,

Army Engineer Waterways Experiment Station

Vicksburg, Miss.

Clara F. Derrington, and Leonard Pepper.

8E. Rock Mechanics and Geology

ROCKFILL.
Building Research Station, Watford (England).

For primary bibliographic entry see Field 08D.

Field 08—ENGINEERING WORKS

Group 8G—Materials

Available from the National Technical Information Service as AD-728 813, \$3.00 in paper copy, \$0.95 in microfiche. WES technical report C-71-1, July 1971, 76 p.

Descriptors: *Epoxy resins, *Adhesives, *Bonding, *Sealants, *Coatings, *Concrete finishing.

Identifiers: Epoxy compounds.

This report includes (a) a summary of the uses and types of applications, the procedures involved, and the performance of epoxy resins used for civil works projects since 1958; and (b) a guide for recommended practice for use of epoxy compounds with concrete (Appendix A). A total of 80 applications of epoxy resins are discussed, with the type and number of applications as follows: (a) bonding fresh to hardened concrete, 33; (b) patching and filling and repairing cracks, 25; (c) applying protective coating, waterproofing, and sealing joints, 8; (d) bonding metal to hardened concrete, 10; (e) applying coatings for erosion resistance, 3; and (f) bonding hardened concrete to hardened concrete, 1. The performance of 15 of these 80 applications of epoxy resins was rated as unsatisfactory or poor. Causes for the unsatisfactory performance are attributed to wet or damp substrates, insufficient removal of unsound material around area being bonded or patched, weakened surface conditions caused by bushhammering, and softening of cured epoxy when immersed in water. It is essential that proper techniques of mixing the epoxy components, of surface preparation, and of application, and a properly selected epoxy formulation be used for optimum performance. Appendix A should prove beneficial for personnel using epoxy resins with concrete.

W72-02120

8H. Rapid Excavation

OWNER-ENGINEER-CONTRACTOR RELATIONSHIPS IN TUNNELING, Bureau of Reclamation, Washington, D. C.

E. L. Armstrong.

Paper, Engineering Foundation 3rd Conference on Rapid Excavation, Deerfield, Mass, July 1971. 8 p.

Descriptors: *Contracting, *Tunneling, Tunnel design, Engineering, Innovation, Underground structures, Construction, Specifications, Contracts, Contract administration, Tunnel construction, Rapid excavation, Cooperation, Subsurface investigations.

Identifiers: Changed conditions.

The accumulating need for tunnels, today and in the future, requires improvement in owner-engineer-contractor relations for underground excavation. The push to go underground is here now and will accelerate in the future. Innovations, rather than easing the owner-engineer-contractor relations, are placing increased obligations and complications on all parties involved as new developments are incorporated into plans and specifications. The owner has the right to expect that when bids are in, his engineers have used diligence, reasonable skills and good business judgment in preparing designs and specifications. The engineer's job is difficult; he must secure adequate geological data, have them evaluated and translated into a good design capable of accomplishment by modern and economical methods of construction. The tunnel contractor must be able to visualize the methods and skills involved. He must obtain equipment, financing, and crew for a sound business operation. Shortcomings must be identified, needed changes recognized, and full cooperation among the contractor, the owner, and the engineer must be established. Other suggestions for improved owner-engineer-contractor relationships are discussed. (USBR)

W72-01764

8I. Fisheries Engineering

RECENT CHANGES IN THE MOVEMENTS OF ADULT SALMON *SMO SALAR L.* IN THE TAY-TUMMEL-GARRY SYSTEM, SCOTLAND, Edinburgh Univ. (Scotland). School of Medicine.

Michael L. G. Gardner.

J Fish Biol. 3 (1): 83-96. Illus. Map. 1971.

Identifiers: Adult, Movements, *Salmo-Salar*, Salmon, Scotland, System, Tay-Tummel-Garry.

Records from salmon counters at hydro-electric dams, and of angling results, in the Tay-Tummel-Garry river system are analyzed. Spring runs of ascending salmon have decreased since at least 1950, but summer and autumn runs have increased since 1959. Hydro-electric developments are not responsible for these changes, nor for the decrease in the average weight of salmon in the system. Possible environmental factors are discussed, and a method suggested whereby the ratio of sizes of salmon populations in branches of a river system may be estimated. The numbers of descending kelts have recently increased, but the times of downstream migration have not changed. --Copyright 1971, Biological Abstracts, Inc.

W72-01917

FISH MANAGEMENT IN THE OB RIVER BASIN IN THE LIGHT OF POSSIBLE CONSTRUCTION OF THE LOWER OB HYDROELECTRIC POWER PLANT (RYBNOYE KHOZYAYSTVO OBSKOGO BASSEYNA PRI USLOVII SOZDANIYA NIZHNE-ORSKOY GES), For primary bibliographic entry see Field 04A.

W72-02024

ECOLOGY OF THE TIGER-FISH (HYDROCYNUS VITTATUS) IN THE INCOMATI RIVER SYSTEM, SOUTH AFRICA, Provincial Fish Inst., Lydenburg (South Africa).

I. G. Gaigher.

Zool Afr. 5 (2): 211-227. Illus. 1970.

Identifiers: Africa, Bertalanffy, Diet, Ecology, Equation, Growth, *Hydrocynus-Vittatus*, Incomati, River, South, System, Tiger-Fish.

A general description of the Incomati River system refers to topography, climate and physical condition of the water. The range of *H. vittatus* was considerably reduced after the construction of weirs which prevented successful upstream movement. There was a downstream movement into Mozambique after the 1st floods and an upstream movement after prey at the end of the rainy season. The condition of tiger-fish changed markedly during the course of a year. Scale studies indicate that the annulus is a reliable year-mark. A Von Bertalanffy growth-in-length equation fitted to the data is described by the equation $L_t = (1 - e^{-0.25(t-0.12)})$. Males reach sexual maturity at a length of 200 and females at a length of approximately 360 mm. Spawning takes place among aquatic vegetation on flooded river banks and in lakes in Mozambique after the first heavy floods. As the fish grows, its food changes from Entomostraca to insects and finally to fish. The food habits of fish over 90 mm in length showed a seasonal variation dependent on the availability of fish prey. A tiger-fish is unable to swallow fish larger than half its own length. --Copyright 1971, Biological Abstracts, Inc.

W72-02185

10. SCIENTIFIC AND TECHNICAL INFORMATION

A DECADE OF EHV TRANSMISSION IN THE SOVIET UNION—AN ANNOTATED BIBLIOGRAPHY,

Bureau of Reclamation, Denver, Colo.

For primary bibliographic entry see Field 08C.

W72-01766

OXYGEN SAG AND STREAM SELF-PURIFICATION,

For primary bibliographic entry see Field 05C.

W72-01785

A CRITICAL REVIEW OF CURRENTLY AVAILABLE HYDROLOGIC MODELS FOR ANALYSIS OF URBAN STORMWATER RUNOFF,

Hydrocomp International Inc., Palo Alto, Calif.

For primary bibliographic entry see Field 02A.

W72-01978

CHARACTERISTICS AND POLLUTION PROBLEMS OF IRRIGATION RETURN FLOW,

Utah State Univ., Foundation, Logan.

For primary bibliographic entry see Field 05B.

W72-01984

DESIGN AND OPERATION OF AN INFORMATION CENTER ON ANALYTICAL METHODOLOGY,

Battelle Memorial Inst., Columbus, Ohio. Analytical Methodology Information Center.

Copy available from GPO Sup Doc as EP2.10: 16020 FSO 06/71, \$1.25; microfiche from NTIS as PB-204 820, \$0.95. June 1971, Final Report, Contract No 14-12-862. 175 p. Program 16020FS06/71.

Descriptors: Information retrieval, Data collections, Automation, Digital computers, Cost analysis, Chemical analysis, Analytical techniques, Aquatic microbiology, Instrumentation.

Identifiers: Information centers, Information storage and retrieval systems.

Under WQO Contract Number 14-12-862, the Columbus Laboratories of Battelle Memorial Institute were commissioned to design and operate a pilot analytical methodology information storage and retrieval system tailored to the needs of the Analytical Quality Control Laboratory (AQCL) and other segments of the National Analytical Methods and Development Research Program (NAMDRP). The contractual requirements were met during a nine-month research period by the following activities: definition and statement of the AQCL scope of interests; acquisition of a total of 1145 technical reports and articles; abstracting and indexing of 470 technical documents; preparation of three prototype issues of a current awareness bulletin entitled 'Reviews of Current Literature on Analytical Methodology'; preparation of 115 items for input to the Water Resources Scientific Information Center; provision of 13 quick responses to technical inquiries as well as other information services such as document loans and translations; consideration of methods for interacting with other facilities such as the Science Information Exchange (SIE); development of a procedure for processing and inputting information to a computerized information storage and retrieval system; demonstration of a computerized information storage and retrieval system at AQCL; Recommendations for an operational information center on analytical methodology; cost analysis of the recommended information center. Complete discussions of all these activities are included in the report. (Little-Battle) W72-01994

ELECTRODIALYSIS DESALTING STATE-OF-THE-ART (1969).

Hittman Associates, Inc., Columbia, Md.

For primary bibliographic entry see Field 03A.

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1970 LITERATURE REVIEW, ADMINISTRATION: ECONOMICS,

Rutgers-The State Univ., New Brunswick, N. J.

Water Resources Research Inst.

For primary bibliographic entry see Field 06B.

W72-02140

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SUBJECT INDEX

2-4-D	Movement and Adsorption of Pesticides in Sterilized Soil Columns, W72-01697	5B	W72-02061	4A	W72-02075	5E
			Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov basseyna r. Obi), W72-02062	4A	Bosarge V. State (Outer Limits of Alabama's Territorial Jurisdiction), W72-02133	6E
ACACOM	A Study of Reinsertion Transient Voltages for Series Capacitors on USBR Glen Canyon - Flagstaff 345 KV Lines, W72-01775	8C			ALASKA	
			ADMINISTRATIVE AGENCIES		Ground-Water Exploration, Beaver Creek Valley Near Kenai, Alaska, W72-02087	4B
ACCELERATED EROSION	Control of Sediments Resulting from Highway Construction and Land Development, W72-02106	2J	A Bill to Amend the Federal Water Pollution Control Act to Provide Financial Assistance for River Basin Programs, W72-02141	6E	ALBEDO	
			A Welter of Ideas--A Modicum of Coordination, W72-02151	5G	Albedo of Melting Sea Ice in the Southern Beaufort Sea, W72-01711	2C
ACCRETION (LEGAL ASPECTS)	State V. Johnson (Boundary of Land Bounded by an Inlet which Closed by Accretion), W72-02201	6E	ADSORPTION		ALGAE	
			Movement and Adsorption of Pesticides in Sterilized Soil Columns, W72-01697	5B	Suggested Classification of Algae and Protozoa in Sanitary Science, W72-01798	5C
ACID MINE WATER	Aquatic Life in Waters Polluted by Acid Mine Waste, W72-01796	5C	Sorption and Desorption of Chlorinated Hydrocarbon Pesticides in Aquatic Sediment Minerals, W72-01779	5B	Chemical Composition of Algae and its Relationship to Taste and Odor, W72-01812	5A
			Mechanism and Kinetics of Substrate Utilization at High Biological Solids Concentrations, W72-01843	5D	Biological Factors in Treatment of Raw Sewage in Artificial Ponds, W72-01818	5D
ACIDITY	The Effects of Acid Mine Pollution on the Fish Population of Goose Creek, Clay County, Kentucky, W72-01806	5C	Removal of Orthophosphates From Aqueous Solutions with Activated Alumina, W72-01847	5D	Chemistry of Nitrogen and Phosphorus in Water, W72-01867	5C
			AERATION		Aerobic Decomposition of Algae, W72-01881	5D
			Aerator Performance in Natural Streams, W72-01842	5G	Iodine and Algae in Sedimentary Rocks Associated with Iodine-Rich Brines, W72-02073	2K
ACOUSTIC EMISSION ANALYSIS	Field Evaluation of Heavy-Walled Pressure Vessels Using Acoustic Emission Analysis, W72-01776	8G	AEROBIC BACTERIA		ALGAL CONTROL	
			Inka Aeration at Hazleton, Pennsylvania, W72-01844	5D	Pre-Treatment Basin for Algae Removal, W72-01814	5F
ACTIVATED ALUMINA	Removal of Orthophosphates From Aqueous Solutions with Activated Alumina, W72-01847	5D	AEROBIC CONDITIONS		ALPINE	
			The Biochemical Aspects of Aerobic Bacterial Growth, W72-01870	5F	Permafrost Occurrence in the Front Range, Colorado Rocky Mountains, U.S.A., W72-01712	2C
ACTIVATED CARBON	Coagulation of Activated Carbon Suspensions, W72-01862	5E	AEROBIC TREATMENT		ALUM	
			Aerobic Decomposition of Algae, W72-01881	5D	Virus Inactivation During Phosphate Precipitation, W72-01852	5D
ACTIVATED SLUDGE	Protozoa and Activated Sludge, W72-01817	5D	AEROSOLS		Coagulation of Activated Carbon Suspensions, W72-01862	5E
			Viability of Long-Stored Airborne Bacterial Aerosols, W72-01882	5D	ALUMINUM	
			Plutonium-239 in and Over the Atlantic Ocean, W72-02083	5B	Effect of Sulfate and Other Ions in Coagulation with Aluminum, W72-01869	5D
			AGRICULTURE		AMINO ACIDS	
			Against Monoculture, W72-01762	3F	Chemical Composition of Algae and its Relationship to Taste and Odor, W72-01812	5A
ADHESIVES	Measurement, Control and Changes in Foaming Characteristics of Pulping Wastes During Biological Treatment, W72-01877	5D	AIR POLLUTION		ANACOSTIA RIVER (DC)	
			Industry/Government Teleconference on Pollution Control, W72-02155	5G	The Anacostia River, Ecological Imbalance of an Urban Stream Valley, W72-02093	5C
ADMINISTRATION	Survey of Applications of Epoxy Resins for Civil Works Projects, W72-02120	8G	ANADROMOUS FISH		ANADROMOUS FISH	
					Oxygen Requirements of Some Marine and Anadromous Fishes, with Particular Reference to Problems of Measurement, W72-01875	5C
					Nitrogen Supersaturation in the Columbia and Snake Rivers,	

SUBJECT INDEX

ANADROMOUS FISH

W72-02159	5B	W72-01759	3F	W72-01731	2F
Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers,		AQUATIC ALGAE		Change of Chloride Content of Water in Response to Pumping in the Artesian Aquifer in the Roswell-East Grant Plains Area, Chaves County, New Mexico,	
W72-02160	5B	A Partial Checklist of Florida Fresh-Water Algae and Protozoa with Reference to McCloud and Cue Lakes,		W72-01751	4B
ANAEROBIC DIGESTION		W72-01993	5A	Concentration Gradients in Aquifers,	2F
Biological Treatment of Beef Animal Wastes,		AQUATIC ANIMALS		W72-02055	
W72-01777	5D	Ecology of Animal Saprobia,			
Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notament Des Fabricues de Pate a Papier et d'Huile Vegetale Hydrogenee),		W72-01799	5C	Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektivu ispol'zovaniya podzemnykh vod yugovostochnoy chasti Zapadnoy Sibiri),	
W72-02208	5B	AQUATIC FUNGI		W72-02102	4B
ANALOG MODELS		Microfungi in the Water, Mud, and Litter of a Cattail Marsh,		Optimization in Municipal Water Supply System Design,	
Hydrologic Characterization of Forested Watersheds in Arizona,		W72-02112	5C	W72-02125	6A
W72-01703	2A	AQUATIC LIFE		Recharging the Ogallala Formation Using Shallow Holes,	
ANALYSIS OF COVARIANCE		Some Important Biological Effects of Pollution Often Disregarded in Stream Surveys,		W72-02227	4B
Augmenting Annual Runoff Records Using Tree-Ring Data,		W72-01790	5C	ARCHAEOLOGICAL STUDIES	
W72-02213	2E	Bioaccumulation of Radioisotopes Through Aquatic Food Chains,		Tree-Ring Dating of Colorado River Driftwood in the Grand Canyon,	
ANALYSIS OF VARIANCE		W72-01792	5B	W72-02234	7B
A Stochastic Analysis of Flows on Rillito Creek,		AQUATIC LIFE		ARCTIC	
W72-02224	2E	Waste,		Albedo of Melting Sea Ice in the Southern Beaufort Sea,	
ANALYTICAL TECHNIQUES		W72-01796	5C	W72-01711	2C
The Radiochromatographic Analysis of Fresh Water Resources,		Aquatic Organisms as an Aid in Solving Waste Disposal Problems,		ARCTIC OCEAN	
W72-01981	2K	W72-01801	5C	Temperature and Conductivity Measurements Under Ice Island T-3,	
Analytical Solution for the Wind-Driven Circulation in a Lake Containing an Island,		Stream Life and the Pollution Environment,		W72-02042	2K
W72-02022	2H	W72-01803	5C	ARID LANDS	
A Unifrom Flow Formula for Flumes and Canals,		AQUATIC MICROBIOLOGY		Pattern in Desert Perennials,	
W72-02051	8B	Biological Aspects of Stream Pollution,		W72-01760	2I
Characterization and Identification of Spilled Residual Fuel Oils by Gas Chromatography and Infrared Spectrophotometry,		W72-01789	5C	Seasonal Effects on Soil Drying After Irrigation,	
W72-02196	5A	AQUATIC PLANTS		W72-02217	2D
ANDERSON-CUE LAKE		Ecology of Plant Saprobia,		The Use of a Realistic Rainfall Simulator to Determine Relative Infiltration Rates of Contributing Watersheds to the Lower Gila Below Painted Rock Dam,	
Eutrophication: Small Florida Lakes as Models to Study the Process,		W72-01793	5C	W72-02220	2G
W72-01990	5B	AQUEOUS SOLUTIONS		Mulching Techniques for Arid Lands Vegetable Production,	
ANOMALOUS RAINFALL DISTRIBUTION		Isotope Effect on the Thermodynamic Activity of Water,		W72-02221	3F
Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere,		W72-01695	1A	Physiographic Limitations upon the Use of Southwestern Rivers,	
W72-01741	2B	Saline Waters: Genesis and Relationship to Sediments and Host Rocks,		W72-02235	6B
ANTARCTIC		W72-01755	2K	Use and Abuse of Southwestern Rivers. The Pueblo Dweller,	
Permafrost-Hydrogeologic Regimen in Two Ice-Free Valleys, Antarctica, from Electrical Depth Sounding,		AQUIFER CHARACTERISTICS		W72-02236	3F
W72-02030	2C	Transmissivity Tracts in the Coastal Plain Aquifers of Maryland,		Use and Abuse of Southwestern Rivers. Historic Man--The Spaniard,	
ANTECEDENT DRY PERIODS		W72-01730	2F	W72-02237	4A
A Stochastic Analysis of Flows on Rillito Creek,		Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektivu ispol'zovaniya podzemnykh vod yugovostochnoy chasti Zapadnoy Sibiri),		Use and Abuse of Southwestern Rivers. Historic Man--The Anglo,	
W72-02224	2E	W72-02102	4B	W72-02238	4A
ANTITRANSPIRANTS		Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks in Central Pennsylvania,		ARIZONA	
Effective Drought Control for Successful Dry-land Agriculture,		W72-02115	4B	Hydrologic Characterization of Forested Watersheds in Arizona,	
		AQUIFER TESTS		W72-01702	2C
		An Extended Theory of Delayed Yield from Storage Applied to Pumping Tests in Unconfined Anisotropic Aquifers,		Hydrologic Characterization of Forested Watersheds in Arizona,	
		W72-02011	4B		
		AQUIFERS			
		Uranium and Tritium as Natural Tracers in the Floridan Aquifer,			
		W72-01696	4B		
		Chemical Weathering of the Biscayne Aquifer, Dade County, Florida,			

SUBJECT INDEX

BIOLOGICAL COMMUNITIES

W72-01703	2A	W72-02044	2K	W72-02143	6B
Statistical Inference on Streamflow Processes with Markovian Characteristics, W72-01704	2E	ATMOSPHERE Complexes of Silver Iodide and Secondary Amines, W72-02072	3B	BANK STABILITY Channel Stability in the Estuary: Controls by Bedrock and Unconsolidated Post-Glacial Sediment, W72-01721	2L
Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals, W72-01781	2F	Nitrogen Balance For a 23 Square Mile Minnesota Watershed, W72-02216	2K	BARE SOILS Seasonal Effects on Soil Drying After Irrigation, W72-02217	2D
The Occurrence of Thermal Ground-Water in the Basin and Range Province of Arizona, W72-02229	2F	AUSTRALIA Ecophysiological Studies on Plants in Arid and Semiarid Regions in Western Australia. IV. Comparison of the Field Physiology of the Host, <i>Acacia Grasbyi</i> and its Hemiparasite, <i>Amyema Nestor</i> Under Optimal and Stress Conditions, W72-01740	2I	BARGE DUMPING The Barged Ocean Disposal of Wastes: A Review of Current Practice and Methods of Evaluation, W72-01987	5C
Physiographic Limitations upon the Use of Southwestern Rivers, W72-02235	6B	AUTOMATIC CONTROL A Rational Evaluation of Instrumentation and Control Systems, W72-01823	5D	BASINS Pre-Treatment Basin for Algae Removal, W72-01814	5F
Use and Abuse of Southwestern Rivers. Historic Man-The Spaniard, W72-02237	4A	Toward Computer Control of Wastewater Treatment, W72-01824	5D	BATHING WATER STANDARDS A Critical Examination of Bathing Water Quality Standards, W72-01997	5B
ARKANSAS Digital Simulation of an Existing Water Resources System, W72-02132	6A	AUTOTROPHIC BACTERIA Transformations of Iron by Bacteria in Water, W72-01811	2K	BAYS Observations on Short-Period Internal Waves in Massachusetts Bay, W72-02035	2L
ARTESIAN HEAD Change of Chloride Content of Water in Response to Pumping in the Artesian Aquifer in the Roswell-East Grant Plains Area, Chaves County, New Mexico, W72-01751	4B	BACTERIA Transformations of Iron by Bacteria in Water, W72-01811	2K	BED LOAD Height of Sand Dunes in Open Channel Flows, W72-02021	2J
ARTESIAN WELLS Change of Chloride Content of Water in Response to Pumping in the Artesian Aquifer in the Roswell-East Grant Plains Area, Chaves County, New Mexico, W72-01751	4B	The Chemistry and Biology of Milk Waste Disposal, W72-01816	5D	BEDS Coastal Zone Management-The Tidelands: Legislative Apathy Vs. Judicial Concern, W72-02153	6E
Overpumped Artesian Wells Among a Well Group, W72-02005	4B	Protozoa and Activated Sludge, W72-01817	5D	BEEF ANIMAL WASTES Biological Treatment of Beef Animal Wastes, W72-01777	5D
Requirement for the Capping of Certain Artesian Wells. W72-02186	6E	Biological Factors in Treatment of Raw Sewage in Artificial Ponds, W72-01818	5D	BENTHIC FAUNA Effect of Siltation, Resulting from Improper Logging, on the Bottom Fauna of a Small Trout Stream in the Southern Appalachians, W72-01802	5C
ARTIFICIAL PRECIPITATION Outline of a Bayesian Approach to the EML Multiple Cloud Seeding Experiments, W72-02058	3B	Relationship Between <i>Escherichia Coli</i> , Type I and Enterococci in Water, W72-01854	5B	BENTHOS Control of Benthic Deposits in Lakes, W72-01699	2H
ARTIFICIAL RECHARGE Artificial Ground-Water Recharge by Means of Wells in Israel, W72-02017	4B	Kinetics of the Steady State Bacterial Culture IV. Transfer Rates, W72-01865	5D	BIBLIOGRAPHIES A Decade of EHV Transmission in the Soviet Union-An Annotated Bibliography, W72-01766	8C
Feasibility of Recharging Treated Sewage Effluent into a Deep Sandstone Aquifer, W72-02077	5D	The Biochemical Aspects of Aerobic Bacterial Growth, W72-01870	5F	BIOASSAY Biological Assays and Water Quality in Minnesota, W72-01783	5C
Optimization in Municipal Water Supply System Design, W72-02125	6A	Viability of Long-Stored Airborne Bacterial Aerosols, W72-01882	5D	Aquatic Organisms as an Aid in Solving Waste Disposal Problems, W72-01801	5C
ATLANTIC OCEAN On Potential Density in the Deep South Atlantic Ocean, W72-02037	2E	Natural Relationships of Indicator and Pathogenic Bacteria in Stream Waters, W72-01996	5B	BIODEGRADATION Aerobic Decomposition of Algae, W72-01881	5D
Aleutian Plain Sediments and Lithospheric Plate Motions, W72-02043	2J	A Critical Examination of Bathing Water Quality Standards, W72-01997	5B	BIOINDICATORS Biological Indices of Water Pollution with Special Reference to Fish Population, W72-01791	5C
The Origin of Metal-Bearing Submarine Hydrothermal Solutions.		BAFFLES Drag Forces on Baffle Blocks in Hydraulic Jumps, W72-02019	8B	BIOLOGICAL COMMUNITIES Pattern in Desert Perennials, W72-01760	2I
		BALANCE OF NATURE The Lake as a Microcosm, W72-01787	5C	Against Monoculture,	
		BALTIC SEA Winter Commerce on the Baltic: Some Implications on Opening the Great Lakes.			

SUBJECT INDEX

BIOLOGICAL COMMUNITIES

W72-01762	3F
Trickling Filter Ecology,	
W72-01819	5D
Selection and Adaptation of Microorganisms in	
Waste Treatment,	
W72-01820	5D
BIOLOGICAL PROBLEMS	
Aquatic Biology and the Water Works En-	
gineer,	
W72-01813	5C
BIOLOGICAL PROPERTIES	
Aquatic Biology and the Water Works En-	
gineer,	
W72-01813	5C
BIOLOGICAL TREATMENT	
Biological Treatment of Beef Animal Wastes,	
W72-01777	5D
Measurement, Control and Changes in Foaming	
Characteristics of Pulping Wastes During Biologi-	
cal Treatment,	
W72-01877	5D
Biological Treatment of Strong Industrial	
Waste from a Fiberboard Factory,	
W72-01885	5D
BIOLOGY	
The Lake as a Microcosm,	
W72-01787	5C
BIOASSAY	
Mechanism and Kinetics of Substrate Utiliza-	
tion at High Biological Solids Concentrations,	
W72-01843	5D
BIOTA	
Trickling Filter Ecology,	
W72-01819	5D
BLUE-GREEN ALGAE	
Blue-Green Algal Effects on Some Hydrologic	
Processes at the Soil Surface,	
W72-02218	2G
BODIES OF WATER	
A Statistical Theory of Water Level Fluctua-	
tions in Undrained Bodies of Water (O	
statisticheskoy teorii kolebanii urovney vody v	
besstochnykh vodoyemakh),	
W72-02097	2H
Present-day and Long-term Water and Salt	
Balance of Southern Seas of the USSR (Azov,	
Caspian and Aral) and Possible Changes in Their	
Hydrologic and Hydrochemical Regimes	
(Sovremennyy i perspektivnyy vodnyy i solevoy	
balansy i vozmozhnyye izmeneniya	
gidrologicheskogo i hidrokhimicheskogo rezhimov	
yuzhnykh morey SSSR (Azovskogo,	
Kaspiskogo i Aralskogo).	
W72-02099	2H
BONDING	
Survey of Applications of Epoxy Resins for	
Divil Works Projects,	
W72-02120	8G
BOREHOLE GEOPHYSICS	
A New Bore-Hole Inclinometer,	
W72-02001	2C
BOREHOLE INCLINOMETERS	
A New Bore-Hole Inclinometer,	
W72-02001	2C
BOREHOLES	
A Method of In Situ Stiffness Measure,	

W72-01770	8D	W72-02136	6B
BOTTOM SEDIMENTS			
Control of Benthic Deposits in Lakes,			
W72-01699	2H		
BOUNDARY DISPUTES			
Hill City Compress Co. V. West Kentucky Coal			
Co. (Common Boundary of Louisiana and Mississip-			
pi),			
W72-02195	6E		
State V. Johnson (Boundary of Land Bounded			
by an Inlet which Closed by Accretion).			
W72-02201	6E		
BOUNDARY LAYERS			
Final Report on Control of Concentration			
Polarization in Reverse Osmosis Desalination of			
Water,			
W72-02107	3A		
BOWEN RATIO			
Lysimetric and Energy Balance Determination			
of Slatfence and Tree Windbreak Effects on			
Water Use Efficiency,			
W72-01748	2D		
BRACKISH WATER			
New Water Through Desalting,			
W72-01749	3A		
Field Evaluation of Forced-Flow Elec-			
trodesalination,			
W72-01836	3A		
Large Reverse Osmosis System Technology			
and Module Development,			
W72-02047	3A		
BRIGHTON (COLO)			
Improving Municipal Water Supplies in			
Colorado by Desalting,			
W72-01839	3A		
BRINE DISPOSAL			
New Water Through Desalting,			
W72-01749	3A		
Model Studies of Outfall Systems for Desalina-			
tion Plants (Part I - Flume Study),			
W72-01838	5E		
BRINES			
A Survey of Saline Ground Water as a Mineral			
Resource,			
W72-01754	2K		
Iodine and Algae in Sedimentary Rocks As-			
sociated with Iodine-Rich Brines,			
W72-02073	2K		
BRISTLECONE PINE TREES			
Tree-Ring Dating of Colorado River Driftwood			
in the Grand Canyon,			
W72-02234	7B		
BURIED MEMBRANES			
Synthetic Rubber Canal Lining, Laboratory			
and Field Investigations of Synthetic Rubber			
Sheeting for Canal Lining - Open and Closed			
Conduit Systems Program,			
W72-01763	8G		
BURNING			
Effects of Fire on Water Infiltration Rates in a			
Ponderosa Pine Stand,			
W72-02219	2G		
BUSINESS MULTIPLIER			
Secondary Economic Effects of Irrigation on			
the Colorado High Plains,			
W72-02111	3A		
CELLULOSE ACETATE HOMOPOLYMER			
New and Improved Cellulose Ester Mem-			
branes,			
W72-02111	3A		
CELLULOSE ACETATE METHACRYLATE			
New and Improved Cellulose Ester Mem-			
branes,			
W72-02111	3A		
CENTRAL ARIZONA PROJECT			
Physiographic Limitations upon the Use of			
Southwestern Rivers,			

SUBJECT INDEX

COLLECTIVE UTILITY

6B	W72-02235	6B	W72-02072	3B	W72-01779	5B
CHANNEL IMPROVEMENT						
Navigation Project, Newark Bay, Hackensack and Passaic Rivers, New Jersey, (Final Environmental Statement).						
	W72-01826	8A			Dispersal Patterns of Clay Minerals in the Sediments of the Eastern Mediterranean Sea,	
					W72-01999	2J
Low Cost Storm Drainage With Paved Channels,						
	W72-01880	4A			CLIMATIC DATA	
CHANNEL MORPHOLOGY						
Channel Stability in the Estuary: Controls by Bedrock and Unconsolidated Post-Glacial Sediment,						
	W72-01721	2L			Investigation of the Effects of Urbanization on Precipitation Type, Frequency, Areal and Temporal Distribution,	
					W72-01982	2B
CHELATION						
The Radiochromatographic Analysis of Fresh Water Resources,						
	W72-01981	2K			CLIMATOLOGY	
CHEMICAL ANALYSIS						
The Use of Chemical Hydrographs in Groundwater Quality Studies,						
	W72-02225	5A			The Genesis of Sudden Stratospheric Warmings and the Quasi-Biennial Cycles,	
					W72-02203	2B
CHEMICAL COMPOUNDS' LETHAL LIMIT						
Detection and Measurement of Stream Pollution,						
	W72-01804	5C			Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia,	
					W72-02025	2B
CHEMICAL HYDROGRAPHS						
The Use of Chemical Hydrographs in Groundwater Quality Studies,						
	W72-02225	5A			CLOTH BLINDING	
					Effect of Filter Cloth Structure on Flow Resistance, Bleeding, Blinding and Plant Performance,	
					W72-01878	5D
CHEMICAL INTEGRATING THERMOMETER						
Chemical Integrating Thermometer for Water Temperature Measurement,						
	W72-02013	2K			CLOUD SEEDING	
					Outline of a Bayesian Approach to the EML Multiple Cloud Seeding Experiments,	
					W72-02058	3B
CHEMICAL MIXING						
Management of Artificial Recharge Wells for Groundwater Quality Control,						
	W72-02228	5G			COAGULATION	
					Operating Experiences with Vacuum Filtration at St. Helens: A Solution to the Problem,	
					W72-01849	5D
CHEMICAL PRECIPITATION						
Virus Inactivation During Phosphate Precipitation,						
	W72-01852	5D			Coagulation of Activated Carbon Suspensions,	
					W72-01862	5E
Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notamment Des Fabricues de Pate a Papier et d'Huile Vegetale Hydrogénée),						
	W72-02208	5B			Effect of Sulfate and Other Ions in Coagulation with Aluminum,	
					W72-01869	5D
CHEMICAL PROPERTIES						
Saline Waters: Genesis and Relationship to Sediments and Host Rocks,						
	W72-01755	2K			Virus Removal by Coagulation with Polyelectrolytes,	
					W72-01886	5F
CHEMICAL REACTIONS						
Observations of the Mud-Water Interface,						
	W72-02052	2H			Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notamment Des Fabricues de Pate a Papier et d'Huile Vegetale Hydrogénée),	
					W72-02208	5B
Organic-Inorganic Associations: Their Formation and Involvement in Nutrient Mobilization from the Sediments of Lakes,						
	W72-02053	2H			COASTAL PLAINS	
					Transmissivity Tracts in the Coastal Plain Aquifers of Maryland,	
					W72-01730	2F
Complexes of Silver Iodide and Secondary Amines,						
					COASTS	
					Coastal Zone Management-The Tidelands: Legislative Apathy Vs. Judicial Concern,	
					W72-02153	6E
CLARKE-BUMPPUS PLANKTON SAMPLER						
A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use,						
	W72-01735	5C			COATINGS	
					Survey of Applications of Epoxy Resins for Civil Works Projects,	
					W72-02120	8G
CLAY MINERALS						
Dispersal Patterns of Clay Minerals in the Sediments of the Eastern Mediterranean Sea,						
	W72-01999	2J			COLIFORMS	
					A Critical Examination of Bathing Water Quality Standards,	
					W72-01997	5B
CLAYS						
Sorption and Desorption of Chlorinated Hydrocarbon Pesticides in Aquatic Sediment Minerals,						
					COLLECTIVE UTILITY	
					Collective Utility: A Systems Approach for the Utilization of Water Resources,	

SUBJECT INDEX

COLLECTIVE UTILITY

W72-02232	4B
Comparison of Water Pricing Structures from a Collective Utility Viewpoint,	
W72-02233	6C
COLORADO	
Permafrost Occurrence in the Front Range, Colorado Rocky Mountains, U.S.A.,	
W72-01712	2C
Improving Municipal Water Supplies in Colorado by Desalting,	
W72-01839	3A
Test of the Stroebel Spring - A Supplementary Study of the Fort Carson Expansion Project, Civil Action No. 8920, Tract No. 202, El Paso County, Colorado,	
W72-02088	4B
Secondary Economic Effects of Irrigation on the Colorado High Plains,	
W72-02136	6B
COLORADO RIVER BASIN	
Salinity of Surface Water in the Lower Colorado River - Salton Sea Area,	
W72-02074	2K
Physiographic Limitations upon the Use of Southwestern Rivers,	
W72-02235	6B
COLUMBIA RIVER	
Nitrogen Supersaturation in the Columbia and Snake Rivers,	
W72-02159	5B
Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers,	
W72-02160	5B
COMMERCIAL FISHING	
Bosarge V. State (Outer Limits of Alabama's Territorial Jurisdiction).	
W72-02133	6E
COMMUNITY DEVELOPMENT	
Environment Crises,	
W72-01694	6B
Minimum Design Standards for Community Water Supply Systems (Existing standard-FHA 4517.1) (Draft environmental statement).	
W72-01822	5F
COMMUNITY WATER SUPPLY SYSTEMS	
Minimum Design Standards for Community Water Supply Systems (Existing standard-FHA 4517.1) (Draft environmental statement).	
W72-01822	5F
COMPUTER CONTROL	
Toward Computer Control of Wastewater Treatment,	
W72-01824	5D
COMPUTER MODELS	
Dynamic Simulation of Vertical Infiltration into Unsaturated Soils,	
W72-01782	2G
Empirical Study of Economic-Ecologic Linkages in a Coastal Area,	
W72-02126	6A
Validation of Political Simulation Models - Water Resource Projects,	
W72-02129	6A
Uncertainties in Digital-Computer Modeling of Groundwater Basins,	

W72-02215	2F
COMPUTER PROGRAMS	
Nonlinear Dupuit Equations for the Phreatic Surface of a Semi-Infinite Aquifer,	
W72-02004	2F
An Algorithm for Least Squares Analysis of Drawdown in Observation Wells,	
W72-02008	4B
CONCENTRATION POLARIZATION	
Final Report on Control of Concentration Polarization in Reverse Osmosis Desalination of Water,	
W72-02107	3A
CONCRETE FINISHING	
Survey of Applications of Epoxy Resins for Civil Works Projects,	
W72-02120	8G
CONCRETE PIPES	
Sulfuric Acid Attack on Concrete Sewer Pipe,	
W72-01848	8F
CONDEMNATION	
State V. Johnson (Boundary of Land Bounded by an Inlet which Closed by Accretion).	
W72-02201	6E
CONDITIONAL PROBABILITIES	
Conditional Streamflow Probability Distributions,	
W72-02223	6A
CONFERENCES	
Industry/Government Teleconference on Pollution Control.	
W72-02155	5G
CONFINEMENT PENS	
Subsurface Distribution of Nitrates Below Commercial Cattle Feedlots, Texas High Plains,	
W72-02003	5B
CONNECTICUT	
Drainage Density, Length Ratios, and Lithology in a Glaciated Area of Southern Connecticut,	
W72-01717	2J
CONSTITUTIONALITY	
Coastal Zone Management-The Tidelands: Legislative Apathy Vs. Judicial Concern,	
W72-02153	6E
CONSTRUCTION	
Jacking a Sewer Under an Interstate Highway.	
W72-01856	5D
Fish Management in the Ob River Basin in the Light of Possible Construction of the Lower Ob Hydroelectric Power Plant (Rybnoye khozyaystvo Obskogo basseyna pri uslovii sozdaniya Nizhne-Obskoy GES),	
W72-02064	4A
CONTRACTING	
Owner-Engineer-Contractor Relationships in Tunneling,	
W72-01764	8H
CONTROL SYSTEMS	
A Rational Evaluation of Instrumentation and Control Systems,	
W72-01823	5D
Toward Computer Control of Wastewater Treatment,	

W7
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SUBJECT INDEX

DESALINATION PLANTS

W72-02221	3F	W72-02160	5B	W72-01718	2J	
CROPS Drought Influence on Physiological Processes and Subsequent Growth, W72-01758			3F	DAMSITES Dams and Dikes Across Waterways, W72-02138		
			6E	DENDROCHRONOLOGY Tree-Ring Dating of Colorado River Driftwood in the Grand Canyon, W72-02234		
CRYOLOGY A Hot-Wire Engine to Produce Periodic Grooves on an Ice Surface, W72-01714			2C	DARCY-WEISBACH EQUATION Tidal Choking, W72-01725		
			2L			
Creep of Ice Under Low Stress, W72-02091			2C	DATA COLLECTIONS Mercury Pollution: Michigan's Action Program, W72-01995		
			5B			
CRYSTAL GROWTH Effect of Growth Parameters on Substructure Spacing in NaCl Ice Crystals, W72-02092			2C	New Approach to Hydrologic Data Acquisition, W72-02018		
			7A			
CRYSTALLOGRAPHY A Hot-Wire Engine to Produce Periodic Grooves on an Ice Surface, W72-01714			2C	Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia, W72-02025		
			2B			
An Improved Method for Determining Ice Fabrics, W72-02002			2C	Snow in Ohio, W72-02027		
			2C			
Effect of Growth Parameters on Substructure Spacing in NaCl Ice Crystals, W72-02092			2C	DATA PROCESSING New Approach to Hydrologic Data Acquisition, W72-02018		
			7A			
CULTIVATED LANDS Against Monoculture, W72-01762			3F	Objectives and Methods of Data Processing and Analysis in the Water Treatment Context, W72-02128		
			6A			
CULTURAL CONTROL Against Monoculture, W72-01762			3F	DATA STORAGE AND RETRIEVAL New Approach to Hydrologic Data Acquisition, W72-02018		
			7A			
CURRENT METERS A Biaxial Propeller Current-Meter System for Fixed-Mount Applications, W72-02038			7B	DECISION MAKING Environment Crises, W72-01694		
			6E			
CURRENTS (WATER) Distribution of Suspended Oil Particles Following the Grounding of the Tanker Arrow, W72-02036			5B	Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1, W72-01979		
			6A			
Water Exchange at the Mouth of the Gulf of California, W72-02041			2E	Objectives and Methods of Data Processing and Analysis in the Water Treatment Context, W72-02128		
			6A			
CUTTING MANAGEMENT Economic Evaluation of Some Watershed Management Alternatives on Forest Land in West Virginia, W72-02146			4A	Conditional Streamflow Probability Distributions, W72-02223		
			6A			
CYANOPHYTA A Heavy Mortality of Fishes Resulting from the Decomposition of Algae in the Yahara River, Wisconsin, W72-01797			5C	Collective Utility: A Systems Approach for the Utilization of Water Resources, W72-02232		
			4B			
DAM CONSTRUCTION Dams and Dikes Across Waterways. W72-02138			6E	DECOMPOSING ORGANIC MATTER Ecology of Plant Saprobia, W72-01793		
			5D			
DAM FOUNDATIONS Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769			8E	A Heavy Mortality of Fishes Resulting from the Decomposition of Algae in the Yahara River, Wisconsin, W72-01797		
			5C			
DAMS Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02159			5B	Aerobic Decomposition of Algae, W72-01881		
			5D			
Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers,			8E	DEFORMATION Creep of Ice Under Low Stress, W72-02091		
			2C			
DEFORMATION MODULUS Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769			8E	DEFORMATION MODULUS Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769		
			8E			
DELTA Grand Isle: A Barrier Island in the Gulf of Mexico,			5B	DEFORMATION MODULUS Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769		
			8E			
DESATILATION APPARATUS Field Evaluation of Forced-Flow Electrodemineralization, W72-01836			3A			
			3A			
DESATILATION PLANTS New Water Through Desalting, W72-01749			3A			
			3A			
The Design, Fabrication and Testing of a 1000 Gallon Per Day Tubular Reverse Osmosis Pilot Plant, W72-02045			3A			
			3A			
The Simulation and Optimization of a Single Effect Multi-Stage Flash Desalination Plant,			3A			

SUBJECT INDEX

DESALINATION PROCESS

W72-02131	6A	W72-01728	8B	W72-01821	8A
DESALINATION PROCESS					
Field Evaluation of Forced-Flow Elec-		DISCHARGE (WATER)		DISTRICT OF COLUMBIA	
trodesalination,		Corrective Terms in the Glaciological Balance,		The Anacostia River, Ecological Imbalance of	
W72-01836	3A	W72-01715	2C	an Urban Stream Valley,	
		Surface-Water Resources of the Ob River and		W72-02093	5C
DESALINATION PROCESSES					
New Water Through Desalting,		Ob-Irtish Interfluve (Resursy poverkhnostnykh			
W72-01749	3A	vod r. Obi i Ob'-Irtishskogo mezhdureshch'ya),			
		W72-02065	4A	DIVERSION LOSSES	
Reverse Osmosis Pilot Plant for Desalination of		Management of Artificial Recharge Wells for		On the Economic Impact of Large Diversions	
Sea Water,		Groundwater Quality Control,		of Snake River Waters,	
W72-01831	3A	W72-02228	5G	W72-02124	6D
Constant Total Pressure Evaporation Process		DISINFECTION			
with Heat Reuse by a Built-in Engine,		Determining Chlorine Dioxide and Chlorite,			
W72-01834	3A	W72-01873	5F		
Membranes for Desalination by Reverse Osmo-		DISPERSION			
sis,		Predicting Effects of Dead Zones on Stream			
W72-02046	3A	Mixing,			
		W72-01853	5B		
DESIGN					
Mathematical Foundations for Design: Civil		DISPOSAL		DRAINAGE	
Engineering Systems,		The Barged Ocean Disposal of Wastes: A		Effect of Urbanization on Storm Water Peak	
W72-02127	6A	Review of Current Practice and Methods of		Flows,	
		Evaluation,		W72-01857	4C
		W72-01987	5C		
DESIGN STANDARDS					
Minimum Design Standards for Community		DISSOLVED OXYGEN		DRAINAGE DENSITY	
Water Supply Systems (Existing standard-FHA		Biological Factors in Treatment of Raw Sewage		Drainage Density, Length Ratios, and Litholo-	
4517.1) (Draft environmental statement).		in Artificial Ponds,		gy in a Glaciated Area of Southern Connecticut,	
W72-01822	5F	W72-01818	5D	W72-01717	2J
		Dissolved Oxygen Variations in Stratified			
DESORPTION		Lakes,		DRAINAGE PATTERNS (GEOLOGIC)	
Sorption and Desorption of Chlorinated		W72-01864	5C	Drainage Density, Length Ratios, and Litholo-	
Hydrocarbon Pesticides in Aquatic Sediment		Oxygen Requirements of Some Marine and		gy in a Glaciated Area of Southern Connecticut,	
Minerals,		Anadromous Fishes, with Particular Reference to		W72-01717	2J
W72-01779	5B	Problems of Measurement,			
		W72-01875	5C		
DETERGENTS					
Development of Phosphate-Free		DISSOLVED SOLIDS		DRAWDOWN	
Laundry Detergents,		Evaluation of Effect of Impoundment on Water		Overpumped Artesian Wells Among a Well	
W72-01986	5B	Quality in Cheney Reservoir,		Group,	
		W72-01773	5F	W72-02005	4B
		DISTILLATION		An Algorithm for Least Squares Analysis of	
DEWATERING		Constant Total Pressure Evaporation Process		Drawdown in Observation Wells,	
The De-Watering of Digested Sludge Using		with Heat Reuse by a Built-in Engine,		W72-02008	4B
Synthetic Filtering Agents,		W72-01834	3A	An Extended Theory of Delayed Yield from	
W72-01846	5E	Stabilization of Product Water From Seawater		Storage Applied to Pumping Tests in Unconfined	
		Distillation Plants,		Anisotropic Aquifers,	
		W72-01835	3A	W72-02011	4B
DIFFUSION		DISTRIBUTION PATTERNS			
A Hot-Wire Engine to Produce Periodic		Heavy Minerals of Northern Sand Key, Pinel-		DREDGING	
Grooves on an Ice Surface,		las County, Florida,		Channel Stability in the Estuary: Controls by	
W72-01714	2C	W72-01732	2J	Bedrock and Unconsolidated Post-Glacial Sedi-	
		Dispersal Patterns of Clay Minerals in the Sedi-		ment,	
		ments of the Eastern Mediterranean Sea,		W72-01721	2L
Improved Membranes for Reverse Osmosis,		W72-01999	2J		
W72-01833	3A	The Occurrence of Thermal Ground-Water in		DRIFTWOOD	
		the Basin and Range Province of Arizona,		Tree-Ring Dating of Colorado River Driftwood	
DIFFUSIVITY					
		W72-02229	2F	in the Grand Canyon,	
		DISTRIBUTION SPREADING ERRORS		W72-02234	7B
Improved Membranes for Reverse Osmosis,		Finite-Difference Convection Errors,			
W72-01833	3A	W72-01858	7C	DRILLING	
		DISTRIBUTION SYSTEMS		A New Bore-Hole Inclinometer,	
DIGITAL COMPUTERS					
Toward Computer Control of Wastewater		Transformations of Iron by Bacteria in Water,		W72-02001	2C
Treatment,		W72-01811	2K	DROUGHT RESISTANCE	
W72-01824	5D	Standard Utilities Location.		Drought Influence on Germination and	
				Seedling Emergence,	
Digital Simulation of an Existing Water				W72-01739	3F
Resources System,				Can We Breed for Drought Resistance,	
W72-02132	6A			W72-01757	3F
				Drought Influence on Physiological Processes	
DIKES				and Subsequent Growth,	
Dams and Dikes Across Waterways.				W72-01758	3F
W72-02138	6E			Effective Drought Control for Successful Dry-	
				land Agriculture,	
DISCHARGE COEFFICIENTS				W72-01759	3F
Linear Proportional Weirs with Trapezoidal				DRUM SPEED	
Bottoms,				Operating Experiences with Vacuum Filtration	
W72-01728	8B			at St. Helens: A Solution to the Problem,	
				W72-01849	5D
DISCHARGE MEASUREMENT					
Linear Proportional Weirs with Trapezoidal				DRY FARMING	
Bottoms,				Effective Drought Control for Successful Dry-	
				land Agriculture,	

SUBJECT INDEX

				ENERGY DISSIPATION	
W72-01759	3F	W72-02126	6A	W72-02148	6E
DRYING					
Drying Rates of Birdsfoot Trefoil Seed, W72-02089	3F	ECONOMIC EFFICIENCIES Comparison of Water Pricing Structures from a Collective Utility Viewpoint, W72-02233		ECOSYSTEM STRESS The Response of a Specialized Aquatic Ecosystem, The Duckweed Rhizosphere, to Selected Environmental Influences, W72-02114	
DRYING RATES					
Drying Rates of Birdsfoot Trefoil Seed, W72-02089	3F	ECONOMIC EFFICIENCY Inertial Forecast of Water Storage in Soil and its Economic Effectiveness (Inertsionnyy prognoz pochvennykh vlagozapasov i yego ekonomicheskaya effektivnost'). W72-02095		ECOSYSTEMS Predicting Variations in Energy Flow Through a Semi-Controlled Lotic Ecosystem, W72-01701	
DUCKWEED					
The Response of a Specialized Aquatic Ecosystem, The Duckweed Rhizosphere, to Selected Environmental Influences, W72-02114	5C	ECONOMIC EVALUATION Winter Commerce on the Baltic: Some Implications on Opening the Great Lakes, W72-02143		EFFLUENTS Model Studies of Outfall Systems for Desalination Plants (Part I - Flume Study), W72-01838	
DUNES					
Height of Sand Dunes in Open Channel Flows, W72-02021	2J	ECONOMIC FEASIBILITY Preliminary Study of the Development of Water Resources of the Humacao Sub-region, Puerto Rico, W72-01829		BIOLOGICAL TREATMENT OF STRONG INDUSTRIAL WASTE FROM A FIBERBOARD FACTORY, W72-01885	
DUPUIT-FORCHHEIMER THEORY					
Nonlinear Dupuit Equations for the Phreatic Surface of a Semi-Infinite Aquifer, W72-02004	2F	ECONOMIC IMPACT On the Economic Impact of Large Diversions of Snake River Waters, W72-02124		EL PASO COUNTY (COLO) Test of the Stroebel Spring - A Supplementary Study of the Fort Carson Expansion Project, Civil Action No. 8920, Tract No. 202, El Paso County, Colorado, W72-02088	
DYNAMIC PROGRAMMING					
On the Economic Impact of Large Diversions of Snake River Waters, W72-02124	6D	ELECTRODIALYSIS Electrodialysis Desalting State-of-the-Art (1969), W72-02108		ELASTOMERS Synthetic Rubber Canal Lining, Laboratory and Field Investigations of Synthetic Rubber Sheeting for Canal Lining - Open and Closed Conduit Systems Program, W72-01763	
MATHEMATICAL FOUNDATIONS FOR DESIGN: CIVIL ENGINEERING SYSTEMS					
Mathematical Foundations for Design: Civil Engineering Systems, W72-02127	6A	ECONOMIC POLICY Thermodynamics of Environmental Degradation, W72-02137		ELECTRODIALYSIS Field Evaluation of Forced-Flow Electrodemineralization, W72-01836	
IRRIGATION PLANNING 2: CHOOSING OPTIMAL ACRESAGES WITHIN A SEASON					
Irrigation Planning 2: Choosing Optimal Acresages Within a Season, W72-02130	6A	ECONOMIC PREDICTION Inertial Forecast of Water Storage in Soil and its Economic Effectiveness (Inertsionnyy prognoz pochvennykh vlagozapasov i yego ekonomicheskaya effektivnost'), W72-02095		ELECTRODIALYSIS Electrodialysis Desalting State-of-the-Art (1969), W72-02108	
OPTIMAL UTILIZATION OF PLAYA LAKE WATER IN IRRIGATION					
Optimal Utilization of Playa Lake Water in Irrigation, W72-02231	3F	ECONOMICS Empirical Study of Economic-Ecologic Linkages in a Coastal Area, W72-02126		ELECTRONIC EQUIPMENT A Rational Evaluation of Instrumentation and Control Systems, W72-01823	
E. COLI					
Relationship Between Escherichia Coli, Type I and Enterococci in Water, W72-01854	5B	ECONOMIC LOSS The Effects of Acid Mine Pollution on the Fish Population of Goose Creek, Clay County, Kentucky, W72-01806		ELECTROLYTES Virus Removal by Coagulation with Polyelectrolytes, W72-01886	
EFFECTION OF SULFATE AND OTHER IONS IN COAGULATION WITH ALUMINUM					
Effect of Sulfate and Other Ions in Coagulation with Aluminum, W72-01869	5D	ECONOMIC POLICY Thermodynamics of Environmental Degradation, W72-02137		ELK RIVER BASIN (W.VA) Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia, W72-02025	
EASEMENTS					
What Constitutes Natural Drainway or Watercourse for Flow of Surface Water, W72-02156	6E	ECONOMIC PREDICTION Inertial Forecast of Water Storage in Soil and its Economic Effectiveness (Inertsionnyy prognoz pochvennykh vlagozapasov i yego ekonomicheskaya effektivnost'), W72-02095		EMBANKMENT SUBSIDENCE Rockfill, W72-01765	
EAST RIVER					
Effects of Temporary and Permanent Blankets on Tides and Currents in East River, Hydraulic Model Investigation, W72-01827	8A	ECONOMICS Empirical Study of Economic-Ecologic Linkages in a Coastal Area, W72-02126		EMBANKMENTS Rockfill, W72-01765	
ECOLOGICAL DISTRIBUTION					
Pattern in Desert Perennials, W72-01760	2I	ECONOMICS Thermodynamics of Environmental Degradation, W72-02137		ENERGY BUDGET Energy Balance and Spectral Properties of a Reflectored Soybean Canopy, W72-01747	
ECOLOGY					
Predicting Variations in Energy Flow Through a Semi-Controlled Lotic Ecosystem, W72-01701	2I	ECONOMICS 1970 Literature Review, Administration: Economics, W72-02140		LYSIMETRIC AND ENERGY BALANCE DETERMINATION OF SLATFENCE AND TREE WINDBREAK EFFECTS ON WATER USE EFFICIENCY, W72-01748	
ECOLOGICAL STUDIES OF OUTFALL SYSTEMS FOR DESALINATION PLANTS (PART I - FLUME STUDY)					
Model Studies of Outfall Systems for Desalination Plants (Part I - Flume Study), W72-01838	5E	ECONOMICS Concepts Used as Economic Criteria for a System of Water Rights, W72-02140		ENERGY DISSIPATION Drag Forces on Baffle Blocks in Hydraulic Jumps, SU-9	
THE ANACOSTIA RIVER, ECOLOGICAL IMBALANCE OF AN URBAN STREAM VALLEY					
The Anacostia River, Ecological Imbalance of an Urban Stream Valley, W72-02093	5C	ECONOMICS Concepts Used as Economic Criteria for a System of Water Rights, W72-02140		ENERGY DISSIPATION Drag Forces on Baffle Blocks in Hydraulic Jumps, SU-9	
EMPIRICAL STUDY OF ECONOMIC-ECOLOGIC LINKAGES IN A COASTAL AREA					

SUBJECT INDEX

ENERGY DISSIPATION

W72-02019	8B	W72-01826	8A	W72-01848	8F
Hydraulic Jump Assisted by Cross-Jet, W72-02020	8B	'S' Street Channel Improvements, Needles, San Bernardino County, California, Environmental Statement (Environmental statement).	8A	EUTROPHICATION Phytoplanktonic Nitrogen as an Index of Cul- tural Eutrophication, W72-01780	SC
ENTEROCOCCI Relationship Between Escherichia Coli, Type I and Enterococci in Water, W72-01854	5B	W72-01828	8A	Chemistry of Nitrogen and Phosphorus in Water. W72-01867	5C
ENTHALPY Isotope Effect on the Thermodynamic Activity of Water, W72-01695	1A	EPHEMERAL STREAMS Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals, W72-01781	2F	Eutrophication: Small Florida Lakes as Models to Study the Process, W72-01990	5B
ENTROPY Isotope Effect on the Thermodynamic Activity of Water, W72-01695	1A	Periodical, Seasonal, or Intermittent Stream as a Watercourse. W72-02157	6E	Application of Mathematical Models to the Eutrophication Process, W72-01991	5B
ENVIRONMENTAL DEGRADATION Thermodynamics of Environmental Degradation, W72-02137	5G	A Stochastic Analysis of Flows on Rillito Creek, W72-02224	2E	A Partial Checklist of Florida Fresh-Water Algae and Protozoa with Reference to McCloud and Cue Lakes, W72-01993	5A
ENVIRONMENTAL EFFECTS Some Important Biological Effects of Pollution Often Disregarded in Stream Surveys, W72-01790	5C	EPIDEMIOLOGY Water-Borne Typhoid Epidemic at Keene, New Hampshire, W72-01810	5C	Microfungi in the Water, Mud, and Litter of a Cattail Marsh, W72-02112	5C
Minimum Design Standards for Community Water Supply Systems (Existing standard-FHA 4517.1) (Draft environmental statement). W72-01822	5F	EPOXY RESINS Survey of Applications of Epoxy Resins for Civil Works Projects, W72-02120	8G	EVALUATION A Methodology Study to Develop Evaluation Criteria for Wild and Scenic Rivers: Landowner Perception of Recreationist Associated Conflicts in the Salmon-Little Salmon River Corridor of Idaho, W72-01746	6B
Navigation Project, Newark Bay, Hackensack and Passaic Rivers, New Jersey, (Final Environ- mental Statement). W72-01826	8A	EQUATIONS Nonlinear Dupuit Equations for the Phreatic Surface of a Semi-Infinite Aquifer, W72-02004	2F	Outline of a Bayesian Approach to the EML Multiple Cloud Seeding Experiments, W72-02058	3B
'S' Street Channel Improvements, Needles, San Bernardino County, California, Environmen- tal Statement (Environmental statement). W72-01828	8A	A Unifrom Flow Formula for Flumes and Canals, W72-02051	8B	Inertial Forecast of Water Storage in Soil and its Economic Effectiveness (Inertsionnyy prog- noz pochvennykh vlagozapasov i yego ekonomicheskaya effektivnost'), W72-02095	2G
Investigation of the Effects of Urbanization on Precipitation Type, Frequency, Areal and Tem- poral Distribution, W72-01982	2B	EQUIPMENT A Stable Spar-Buoy Platform for Mounting In- strumentation, W72-02039	7B	EVAPORATION Hydrologic Factors in the Determination of Watershed Yields, W72-01700	2A
Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestest- vennyye usloviya ulazhneniya territorii Obskogo basseyne i perspektivy gidromelioratsiyi), W72-02063	4A	EROSION Terraces and Pediment-Terraces in the Southwest: An Interpretation, W72-01719	2J	Saline Waters: Genesis and Relationship to Sediments and Host Rocks, W72-01755	2K
Hydrologic Effects of Water Control and Management of Southeastern Florida, W72-02090	4A	EROSION CONTROL 'S' Street Channel Improvements, Needles, San Bernardino County, California, Environmen- tal Statement (Environmental statement). W72-01828	8A	Constant Total Pressure Evaporation Process with Heat Reuse by a Built-in Engine, W72-01834	3A
Control of Sediments Resulting from Highway Construction and Land Development, W72-02106	2J	ESSENTIAL NUTRIENTS Eutrophication: Small Florida Lakes as Models to Study the Process, W72-01990	5B	Influences of Exposure on Pan Evaporation in a Mountainous Area, W72-02119	2D
ENVIRONMENTAL ENGINEERING Navigation Project, Newark Bay, Hackensack and Passaic Rivers, New Jersey, (Final Environ- mental Statement). W72-01826	8A	Application of Mathematical Models to the Eutrophication Process, W72-01991	5B	Seasonal Effects on Soil Drying After Irriga- tion, W72-02217	2D
'S' Street Channel Improvements, Needles, San Bernardino County, California, Environmen- tal Statement (Environmental statement). W72-01828	8A	ESTUARIES Channel Stability in the Estuary: Controls by Bedrock and Unconsolidated Post-Glacial Sediment, W72-01721	2L	EVAPORATION CONTROL Mulching Techniques for Arid Lands Vegetable Production, W72-02221	3F
ENVIRONMENTAL SANITATION A Welter of Ideas--A Modicum of Coordina- tion, W72-02151	5G	Tidal Choking, W72-01725	2L	EXCHANGEABLE CATIONS Long Term Movement of Water and Soil Salinity in the Weathering Zone of Arid Zone Sedi- ments, W72-01753	2G
ENVIRONMENTAL STATEMENT Navigation Project, Newark Bay, Hackensack and Passaic Rivers, New Jersey, (Final Environ- mental Statement).		The Prevention of Pollution in Estuaries, W72-01883	5G	EXPLORATION Geothermics in North America: Present and Future.	

SUBJECT INDEX

				FLORIDA	
W72-01756	4B	W72-02046	3A	W72-01806	5C
EXTRA HIGH VOLTAGE					
A Decade of EHV Transmission in the Soviet Union--An Annotated Bibliography, W72-01766					
	8C				
EXTRA LONG DISTANCE					
A Decade of EHV Transmission in the Soviet Union--An Annotated Bibliography, W72-01766					
	8C				
FALKLAND ISLANDS					
Evidence of Cirque Glaciation in the Falkland Islands, W72-01713					
	2J				
FALLOUT					
Plutonium-239 in and Over the Atlantic Ocean, W72-02083					
	5B				
Cesium-137 in the North Atlantic Measured by Selective Absorption in Situ, W72-02084					
	5B				
FARM LAGOONS					
Biological Treatment of Beef Animal Wastes, W72-01777					
	5D				
FARM WASTES					
Biological Treatment of Beef Animal Wastes, W72-01777					
	5D				
Subsurface Distribution of Nitrates Below Commercial Cattle Feedlots, Texas High Plains, W72-02003					
	5B				
The Disposal of Agricultural Waste, W72-02142					
	5E				
FARMS					
The Disposal of Agricultural Waste, W72-02142					
	5E				
FEASIBILITY					
Improving Municipal Water Supplies in Colorado by Desalting, W72-01839					
	3A				
FEASIBILITY STUDIES					
Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye osvoyeniye vodnykh resursov Oskogo basseya), W72-02061					
	4A				
Fish Management in the Ob River Basin in the Light of Possible Construction of the Lower Ob Hydroelectric Power Plant (Rybnoye khozyaystvo Oskogo basseyna pri uslovii sozdaniya Nizhne-Obskoy GES), W72-02064					
	4A				
FEDERAL GOVERNMENT					
National Water Quality Standards Act of 1971. W72-02154					
	5G				
FEDERAL POWER ACT					
Dams and Dikes Across Waterways. W72-02138					
	6E				
FEDERAL PROJECT POLICY					
New Water Through Desalting, W72-01749					
	3A				
Water Quality Management Planning in South Carolina: A Planning Manual. W72-01825					
	6D				
FEED WATER					
Membranes for Desalination by Reverse Osmosis,					
FERTILIZERS					
Effects of Recent and Past Phosphate Fertilization on the Amount of Phosphorus Percolating Through Soil Profiles into Subsurface Waters, W72-01691					
	2G				
FIBER-OPTICS					
Optical Fourier Transform Technique for Measuring Sediment Concentration, W72-02158					
	2J				
FILTRATION					
A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use, W72-01735					
	5C				
Numerical Solution of Filtration Equations, W72-01841					
	5D				
The De-Watering of Digested Sludge Using Synthetic Filtering Agents, W72-01846					
	5E				
Theoretical Evaluation of Filter Modeling Experiments, W72-01859					
	5E				
Effect of Filter Cloth Structure on Flow Resistance, Bleeding, Blinding and Plant Performance, W72-01878					
	5D				
FINLAND					
Winter Commerce on the Baltic: Some Implications on Opening the Great Lakes, W72-02143					
	6B				
FISH					
Sewage, Algae and Fish, W72-01788					
	5C				
Biological Indices of Water Pollution with Special Reference to Fish Population, W72-01791					
	5C				
Value of the Bottom Sampler in Demonstrating the Effects of Pollution on Fish-Food Organisms and Fish in the Shenandoah River, W72-01800					
	5C				
The Effects of Sewage Pollution on the Fish Population of a Midwestern Stream, W72-01805					
	5C				
FISH FOOD ORGANISMS					
Value of the Bottom Sampler in Demonstrating the Effects of Pollution on Fish-Food Organisms and Fish in the Shenandoah River, W72-01800					
	5C				
FISH MANAGEMENT					
Fish Management in the Ob River Basin in the Light of Possible Construction of the Lower Ob Hydroelectric Power Plant (Rybnoye khozyaystvo Oskogo basseyna pri uslovii sozdaniya Nizhne-Obskoy GES), W72-02064					
	4A				
FISH POPULATIONS					
Some Important Biological Effects of Pollution Often Disregarded in Stream Surveys, W72-01790					
	5C				
The Effects of Acid Mine Pollution on the Fish Population of Goose Creek, Clay County, Kentucky,					
FISHERIES					
Detection and Measurement of Stream Pollution, W72-01804					
	5C				
FISHKILL					
A Heavy Mortality of Fishes Resulting from the Decomposition of Algae in the Yahara River, Wisconsin, W72-01797					
	5C				
Oxygen Requirements of Some Marine and Anadromous Fishes, with Particular Reference to Problems of Measurement, W72-01875					
	5C				
FLOC PARTICLES					
Oxygen Diffusion Through a Pure Culture Floc of Zoogloea Ramigera, W72-01851					
	5D				
FLOOD CONTROL					
'S' Street Channel Improvements, Needles, San Bernardino County, California, Environmental Statement (Environmental statement), W72-01828					
	8A				
Preliminary Study of the Development of Water Resources of the Humacao Sub-region, Puerto Rico. W72-01829					
	6D				
FLOOD DAMAGE					
Floods in Harvard Southwest Quadrangle, Northeastern Illinois, W72-02085					
	2E				
FLOOD FREQUENCY					
A Critical Review of Currently Available Hydrologic Models for Analysis of Urban Stormwater Runoff, W72-01978					
	2A				
FLOOD PLAINS					
Floods in Harvard Southwest Quadrangle, Northeastern Illinois, W72-02085					
	2E				
FLOODS					
Determination of the Loop Discharge Rating Curve for Flood Wave Propagation, W72-01724					
	2E				
Formation of Spring Runoff in the Vasyugan'ye (O formirovaniye vesennego stoka v usloviyakh Vasyugan'ya), W72-02068					
	4A				
Floods in Harvard Southwest Quadrangle, Northeastern Illinois, W72-02085					
	2E				
FLORIDA					
Chemical Weathering of the Biscayne Aquifer, Dade County, Florida, W72-01731					
	2F				
Heavy Minerals of Northern Sand Key, Pinellas County, Florida, W72-01732					
	2J				
A Partial Checklist of Florida Fresh-Water Algae and Protozoa with Reference to McCloud and Cue Lakes, W72-01993					
	5A				
Outline of a Bayesian Approach to the EML Multiple Cloud Seeding Experiments,					

SUBJECT INDEX

FLORIDA

W72-02058	3B	W72-02095	2G	W72-02079	5B
A Preliminary Evaluation of Hydrologic Conditions of the Lakeland Ridge Area of Polk County, Florida, W72-02086					
Hydrologic Effects of Water Control and Management of Southeastern Florida, W72-02090					
FLORIDA (SOUTHEAST)					
Hydrologic Effects of Water Control and Management of Southeastern Florida, W72-02090					
FLOTATION					
Colloid Flotation and Adsorbing Colloid Flotation, W72-02105					
FLOW					
Permeability, Brine Content and Temperature of Temperate Ice, W72-01706					
Flow in a Transverse Section of Athabasca Glacier, Alberta, Canada, W72-01708					
Dynamic Fluid Loss During Viscous Flow Through a Porous Vertical Slot, W72-02060					
Determination of the Three-Dimensional Velocity Field in a Glacier, W72-02147					
FLOW AUGMENTATION					
Hydrologic Effects of Water Control and Management of Southeastern Florida, W72-02090					
FLOW CONTROL					
Hydrologic Effects of Water Control and Management of Southeastern Florida, W72-02090					
Requirement for the Capping of Certain Artesian Wells. W72-02186					
FLOW INTERVALS					
Conditional Streamflow Probability Distributions, W72-02223					
FLUMES					
A Unirom Flow Formula for Flumes and Canals, W72-02051					
FLUX DECLINE					
New and Improved Cellulose Ester Membranes, W72-02111					
FOAMING					
Measurement, Control and Changes in Foaming Characteristics of Pulping Wastes During Biological Treatment, W72-01877					
FOOD CHAINS					
Bioaccumulation of Radioisotopes Through Aquatic Food Chains, W72-01792					
FORECASTING					
Inertial Forecast of Water Storage in Soil and its Economic Effectiveness (Inertionnyy program na pochvennykh vlagozapasov i yego ekonomicheskaya effektivnost').					
FOREIGN DESIGN PRACTICES					
A Decade of EHV Transmission in the Soviet Union-An Annotated Bibliography, W72-01766					
FOREST MANAGEMENT					
Progress in Developing Forest Management Guidelines for Increasing Snowpack Water Yields, W72-02230					
FOREST SOILS					
Effects of Fire on Water Infiltration Rates in a Ponderosa Pine Stand, W72-02219					
FORESTRY					
Hydrologic Characterization of Forested Watersheds in Arizona, W72-01702					
Hydrologic Characterization of Forested Watersheds in Arizona, W72-01703					
FRACTURES					
Field Evaluation of Heavy-Walled Pressure Vessels Using Acoustic Emission Analysis, W72-01776					
FREE ENERGY					
Isotope Effect on the Thermodynamic Activity of Water, W72-01695					
FREEZING					
Basement Ice, Ward Hunt Ice Shelf, Ellesmere Island, Canada, W72-01710					
FREQUENCY ANALYSIS					
Estimated Return Periods for Short-Duration Precipitation in Utah, W72-02026					
FT. LUTON (COLO)					
Improving Municipal Water Supplies in Colorado by Desalting, W72-01839					
FT. MORGAN (COLO)					
Improving Municipal Water Supplies in Colorado by Desalting, W72-01839					
G COLI					
Viability of Long-Stored Airborne Bacterial Aerosols, W72-01882					
GALVESTON (TEX)					
Island City Solves Tough Sewerage Problem. W72-01855					
GAMMA PROBABILITY FUNCTIONS					
Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States, W72-02210					
GAS CHROMATOGRAPHY					
The Radiochromatographic Analysis of Fresh Water Resources, W72-01981					
Characterization and Identification of Spilled Residual Fuel Oils by Gas Chromatography and Infrared Spectrophotometry, W72-02196					
GASOLINE					
Gasoline Pollution of a Ground-Water Reservoir - A Case History.					
GEOCHEMISTRY					
Geochemical Interpretations of Groundwater Flow Systems, W72-02007					
GEOGRAPHICAL REGIONS					
Some Geographic Implications of Water-Repellent Soils, W72-01745					
GEOMETRIC PROGRAMMING					
Mathematical Foundations for Design: Civil Engineering Systems, W72-02127					
GEOMORPHOLOGY					
Evidence of Cirque Glaciation in the Falkland Islands, W72-01713					
Drainage Density, Length Ratios, and Lithology in a Glaciated Area of Southern Connecticut, W72-01717					
Terraces and Pediment-Terraces in the Southwest: An Interpretation, W72-01719					
The Chalus Valley and its Terraces: Studies in the History and Regionalization of the Central Elbur (North Iran) (Das Chalus-Tal und Seine Terrassen, Studien Zur Landschaftsgliederung und Landschaftsgeschichte des Mit tleren Elburs, (Nordiran), W72-02207					
GEORGIA					
Oxidation-Reduction Determinations at The Mud-Water Interface, W72-02054					
Requirement for the Capping of Certain Artesian Wells. W72-02186					
GEOSTROPHIC FLOWS					
Water Exchange at the Mouth of the Gulf of California, W72-02041					
GEOTHERMAL GRADIENTS					
The Occurrence of Thermal Ground-Water in the Basin and Range Province of Arizona, W72-02229					
GEOTHERMAL POWER					
Geothermics in North America: Present and Future, W72-01756					
GEOTHERMAL STUDIES					
Geothermics in North America: Present and Future, W72-01756					
The Occurrence of Thermal Ground-Water in the Basin and Range Province of Arizona, W72-02229					
GERMINATION					
Drought Influence on Germination and Seedling Emergence, W72-01739					
GLACIATION					
Evidence of Cirque Glaciation in the Falkland Islands, W72-01713					
GLACIERS					
On the Temperature Profile and the Age Profile in the Central Part of Cold Ice Sheets,					

SUBJECT INDEX

GULF OF MEXICO

W72-01705	2C	W72-02080	5B
Permeability, Brine Content and Temperature of Temperate Ice,		A Preliminary Evaluation of Hydrologic Conditions of the Lakeland Ridge Area of Polk County, Florida,	
W72-01706	2C	W72-02086	4B
Shear Stress at the Base of a Rigidly Cirque Glacier,		Ground-Water Exploration, Beaver Creek Valley Near Kenai, Alaska,	
W72-01707	2C	W72-02087	4B
Flow in a Transverse Section of Athabasca Glacier, Alberta, Canada,		Test of the Stroebel Spring - A Supplementary Study of the Fort Carson Expansion Project, Civil Action No. 8920, Tract No. 202, El Paso County, Colorado,	
W72-01708	2C	W72-02088	4B
The Possible Future Behaviour of Berendson Glacier, Canada - A Further Study,		Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektivny ispol'zovaniya podzemnykh vod yugovo-vostochnoy chasti Zapadnoy Sibiri),	
W72-01709	2C	W72-02102	4B
Corrective Terms in the Glaciological Balance,		Effect of Water Losses from Irrigation Canals on Groundwaters of the Aleysk Irrigation System (Vliyanie poter' vody iz orositel'nykh kanalov na gruntovyye vody Aleyskov orositel'noy sistemy),	
W72-01715	2C	W72-02103	3F
Refraction Seismic Investigation at Zemu Glacier, Sikkim,		The Use of Chemical Hydrographs in Groundwater Quality Studies,	
W72-02000	2C	W72-02225	5A
An Improved Method for Determining Ice Fabrics,		Collective Utility: A Systems Approach for the Utilization of Water Resources,	
W72-02002	2C	W72-02232	4B
Determination of the Three-Dimensional Velocity Field in a Glacier,		GROUNDWATER BASINS	
W72-02147	2C	Change of Chloride Content of Water in Response to Pumping in the Artesian Aquifer in the Roswell-East Grant Plains Area, Chaves County, New Mexico,	
GOVERNMENT FINANCE	6E	W72-01751	4B
A Bill to Amend the Federal Water Pollution Control Act to Provide Financial Assistance for River Basin Programs.		A Survey of Saline Ground Water as a Mineral Resource,	
W72-02141	6E	W72-01754	2K
GRANTS		Uncertainties in Digital-Computer Modeling of Groundwater Basins,	
Water Quality Management Planning in South Carolina: A Planning Manual.		W72-02215	2F
W72-01825	6D	GROUNDWATER CONTAMINATION	
National Water Quality Standards Act of 1971.		Gasoline Pollution of a Ground-Water Reservoir - A Case History,	
W72-02154	5G	W72-02079	5B
GREAT BRITAIN		GROUNDWATER HYDROLOGY	
The Prevention of Pollution in Estuaries,		Ground Water for Irrigation in the Brooten-Belgrade Area, West-Central Minnesota,	
W72-01883	5G	W72-02071	4B
GREAT LAKES		GROUNDWATER MINING	
Winter Commerce on the Baltic: Some Implications on Opening the Great Lakes,		Annual Water Statement, 1970-1971.	
W72-02143	6B	W72-01743	4B
GREAT PLAINS		Physiographic Limitations upon the Use of Southwestern Rivers,	
Soil Moisture Survey, 1970-1971.		W72-02235	6B
W72-01744	2G	GROUNDWATER MOVEMENT	
Saline Lake Basins of the Southern High Plains,		Redistribution of Geothermal Heat by a Shallow Aquifer,	
W72-01752	2F	W72-01720	2F
GROUNDWATER		Nonlinear Dupuit Equations for the Phreatic Surface of a Semi-Infinite Aquifer,	
Concentration Gradients in Aquifers,		W72-02004	2F
W72-02055	2F	Investigations of Moisture Exchange in the Zone of Aeration in Irrigated Land (Issledovaniya vlagobmena v zone aeratsii na oroshayemykh zemlyakh),	
Investigations of Moisture Exchange in the Zone of Aeration in Irrigated Land (Issledovaniya vlagobmena v zone aeratsii na oroshayemykh zemlyakh),		W72-02070	4A
W72-02070	4A	Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektivny ispol'zovaniya podzemnykh vod yugovo-vostochnoy chasti Zapadnoy Sibiri),	
Ground Water for Irrigation in the Brooten-Belgrade Area, West-Central Minnesota,		W72-02021	4B
W72-02071	4B	GROUNDWATER POLLUTION	
Petroleum Contamination of Ground Water in Maryland.		Subsurface Distribution of Nitrates Below Commercial Cattle Feedlots, Texas High Plains,	

SUBJECT INDEX

HACKENSACK RIVER

W72-01718 2J
HACKENSACK RIVER
 Navigation Project, Newark Bay, Hackensack and Passaic Rivers, New Jersey, (Final Environmental Statement).
 W72-01826 8A

HAWAII
 Some Aspects of the Geochemistry of F, Fe and Mn in Coastal Waters and in Fresh-Water Springs on the Southeast Coast of Hawaii,
 W72-01998 2K

HEAT BALANCE
 Characteristics of Atmospheric Precipitation in the Southeastern Part of the West Siberian Plain (Nekotoryye osobennosti atmosfernogo uvlazhneniya na yugo-vostoke Zapadno-Sibirskoy ravniny),
 W72-02100 2B

HEAT TRANSFER
 Redistribution of Geothermal Heat by a Shallow Aquifer,
 W72-01720 2F

HEAVY METALS
 Water Geochemistry of Mining and Milling Operation in the 'New Lead Belt' of Southeast Missouri,
 W72-01692 5B

Mercury Pollution: Michigan's Action Program,
 W72-01995 5B

HEAVY MINERALS (SANDS)
 Heavy Minerals of Northern Sand Key, Pinellas County, Florida,
 W72-01732 2J

HEAVY WATER
 The Influence of Model Membrane Systems on the Structure of Water,
 W72-02109 3A

HERBICIDE ELUTION
 Movement and Adsorption of Pesticides in Sterilized Soil Columns,
 W72-01697 5B

HIGHWAY BEAUTIFICATION
 Enhancement of Ecologic and Aesthetic Values of Water Associated with Interstate Highways,
 W72-01698 4C

HISTORY
 Use and Abuse of Southwestern Rivers. The Pueblo Dweller,
 W72-02236 3F

Use and Abuse of Southwestern Rivers. Historic Man--The Spaniard,
 W72-02237 4A

Use and Abuse of Southwestern Rivers. Historic Man--The Anglo,
 W72-02238 4A

HOOGHLY ESTUARY
 Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notamment Des Fabricues de Pate a Papier et d'Huile Vegetale Hydrogencée),

W72-02208 5B
HOOVER DAM
 Salinity of Surface Water in the Lower Colorado River - Salton Sea Area,
 W72-02074 2K

HORTICULTURAL CROPS
 Mulching Techniques for Arid Lands Vegetable Production,
 W72-02221 3F

HUMACAO (PR)
 Preliminary Study of the Development of Water Resources of the Humacao Sub-region, Puerto Rico.
 W72-01829 6D

HURON RIVER (MICH)
 Natural Relationships of Indicator and Pathogenic Bacteria in Stream Waters,
 W72-01996 5B

HYDRAULIC CONDUCTIVITY
 Time in Transit of Water Moving Vertically for Ground Water Recharge,
 W72-01750 2G

HYDRAULIC JUMP
 Drag Forces on Baffle Blocks in Hydraulic Jumps,
 W72-02019 8B

Hydraulic Jump Assisted by Cross-Jet,
 W72-02020 8B

HYDRAULIC MODELS
 Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation,
 W72-01727 2J

HYDRAULIC STRUCTURES
 Drag Forces on Baffle Blocks in Hydraulic Jumps,
 W72-02019 8B

HYDRAULICS
 Multireservoir Analysis Techniques in Water Quantity Studies,
 W72-02057 4A

HYDRODYNAMIC LIFT
 Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation,
 W72-01727 2J

HYDRODYNAMICS
 Spatial Structure of Inertial-Period Motions in a Two-Layered Sea, Based on Observations,
 W72-02033 2E

HYDROELECTRIC PLANTS
 Fish Management in the Ob River Basin in the Light of Possible Construction of the Lower Ob Hydroelectric Power Plant (Rybnoye khozyaystvo Okskogo basseyna pri usloviu sozdaniya Nizhne-Obskoy GES),
 W72-02064 4A

HYDROELECTRIC POWER
 Pumped Storage: State-of-the-Art.
 W72-01771 8C

Water and Hydroelectric Power Resources of the Upper Irtysh Basin (Vodnyye i vodnoenergeticheskiye resursy basseyna Verkhnego Irtysha),

W72-02067 4A
On the Economic Impact of Large Diversions of Snake River Waters,
 W72-02124 6D

Nitrogen Supersaturation in the Columbia and Snake Rivers,
 W72-02159 5B

Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers,
 W72-02160 5B

HYDROGEOLOGY
 Transmissivity Tracts in the Coastal Plain Aquifers of Maryland,
 W72-01730 2F

Geochemical Interpretations of Groundwater Flow Systems,
 W72-02007 2K

Subsurface Disposal of Liquid Industrial Wastes in Alabama-A Current status Report,
 W72-02075 5E

Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektivnye ispol'zovaniya podzemnykh vod yugo-vostochnoy chasti Zapadnoy Sibiri),
 W72-02102 4B

Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks in Central Pennsylvania,
 W72-02115 4B

Recharging the Ogallala Formation Using Shallow Holes,
 W72-02227 4B

HYDROGRAPH ANALYSIS
 Determination of the Loop Discharge Rating Curve for Flood Wave Propagation,
 W72-01724 2E

HYDROGRAPHS
 Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniya vesennego stoka i yeye realizatsiya dlya prognoza gidrografa),
 W72-02096 2E

The Use of Chemical Hydrographs in Groundwater Quality Studies,
 W72-02225 5A

HYDROLOGIC CYCLE
 Characteristics of Atmospheric Precipitation in the Southeastern Part of the West Siberian Plain (Nekotoryye osobennosti atmosfernogo uvlazhneniya na yugo-vostoke Zapadno-Sibirskoy ravniny),
 W72-02100 2B

HYDROLOGIC DATA
 Annual Water Statement, 1970-1971.
 W72-01743 4B

Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia,
 W72-02025 2B

Estimated Return Periods for Short-Duration Precipitation in Utah,
 W72-02026 2B

Snow in Ohio,

SUBJECT INDEX

INSTRUMENTATION

W72-02027	2C	W72-02076	5E	W72-01745	2G
A Preliminary Evaluation of Hydrologic Conditions of the Lakeland Ridge Area of Polk County, Florida,		Feasibility of Recharging Treated Sewage Effluent into a Deep Sandstone Aquifer, W72-02077	5D	Dynamic Simulation of Vertical Infiltration into Unsaturated Soils, W72-01782	2G
W72-02086	4B	Floods in Harvard Southwest Quadrangle, Northeastern Illinois, W72-02085	2E	Effects of Fire on Water Infiltration Rates in a Ponderosa Pine Stand, W72-02219	2G
Ground-Water Exploration, Beaver Creek Valley Near Kenai, Alaska,		Public Utilities--Water Authorities, W72-02145	6E	The Use of a Realistic Rainfall Simulator to Determine Relative Infiltration Rates of Contributing Watersheds to the Lower Gila Below Painted Rock Dam, W72-02220	2G
W72-02087	4B			Renovating Sewage Effluent by Ground-Water Recharge, W72-02226	5D
Hydrologic Computational Methods for Marine Hydraulic Engineering Construction (Metody morskikh hidrologicheskikh raschetov diya tselye gidrotekhnicheskogo stroitel'stva), W72-02094	2L	IMPACT STATEMENT			
		'S' Street Channel Improvements, Needles, San Bernardino County, California, Environmental Statement (Environmental statement), W72-01828	8A		
HYDROLOGY		IMPOUNDED WATERS			
Hydrologic Characterization of Forested Watersheds in Arizona, W72-01703	2A	Evaluation of Effect of Impoundment on Water Quality in Cheney Reservoir, W72-01773	5F		
		IN SITU TESTS			
Multireservoir Analysis Techniques in Water Quantity Studies, W72-02057	4A	A Method of In Situ Stiffness Measure, W72-01770	8D		
HYDROMETALLURGY		INCOME MULTIPLIER			
A Survey of Saline Ground Water as a Mineral Resource, W72-01754	2K	Secondary Economic Effects of Irrigation on the Colorado High Plains, W72-02136	6B		
		INDIA			
ICE		Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere, W72-01741	2B		
A Hot-Wire Engine to Produce Periodic Grooves on an Ice Surface, W72-01714	2C	INDICATORS			
		The Diversity of Pigments in Lake Sediments and Its Ecological Significance, W72-01784	5C		
Refraction Seismic Investigation at Zemu Glacier, Sikkim, W72-02000	2C	INDUSTRIAL WASTES			
		Biology of Water Pollution: A Collection of Selected Papers on Stream Pollution, Waste Water, and Water Treatment, W72-01786	5C		
An Improved Method for Determining Ice Fabrics, W72-02002	2C	Industrial Wastes as a Source of Tastes and Odors in Water Supplies, W72-01815	5C		
Creep of Ice Under Low Stress, W72-02091	2C	Measurement, Control and Changes in Foaming Characteristics of Pulping Wastes During Biological Treatment, W72-01877	5D		
Effect of Growth Parameters on Substructure Spacing in NaCl Ice Crystals, W72-02092	2C	The Prevention of Pollution in Estuaries, W72-01883	5G		
ICE BREAKUP		Biological Treatment of Strong Industrial Waste from a Fiberboard Factory, W72-01885	5D		
Two Investigations of River Ice: Part I and Part 2, W72-02056	2C	Industry/Government Teleconference on Pollution Control, W72-02155	5G		
ICE FABRICS		INDUSTRIAL WATER			
An Improved Method for Determining Ice Fabrics, W72-02002	2C	Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1, W72-01979	6E		
		Comparison of Plant Water Quality to Proposed Water Quality Standard, W72-02082	5F		
ICE LOADS		INFILTRATION			
Two Investigations of River Ice: Part I and Part 2, W72-02056	2C	Some Geographic Implications of Water-Repellent Soils,			
ICE STRUCTURE					
Effect of Growth Parameters on Substructure Spacing in NaCl Ice Crystals, W72-02092	2C				
ICED LAKES					
Winter Commerce on the Baltic: Some Implications on Opening the Great Lakes, W72-02143	6B				
ILLINOIS					
Redistribution of Geothermal Heat by a Shallow Aquifer, W72-01720	2F				
Subsurface Storage and Disposal in Illinois,					

SUBJECT INDEX

INSTRUMENTATION

W72-01761	2I	W72-02207	4A	W72-02101	3F
A Rational Evaluation of Instrumentation and Control Systems, W72-01823	5D	IRON BACTERIA Transformations of Iron by Bacteria in Water, W72-01811	2K	IRRIGATION RETURN FLOW Characteristics and Pollution Problems of Irrigation Return Flow, W72-01984	5B
A New Bore-Hole Inclinometer, W72-02001	2C	IRRIGATION Ground Water for Irrigation in the Brooten-Brigade Area, West-Central Minnesota, W72-02071	4B	IRRIGATION SYSTEMS Problems in the Irrigation of the Kulunda Steppe (Nekotoryye voprosy orosheniya Kulundinskoy stepi), W72-02101	3F
Chemical Integrating Thermometer for Water Temperature Measurement, W72-02013	2K	Agrometeorological Conditions in the Volga Region and the Effectiveness of Measures to Combat Unfavorable Hydrometeorological Phenomena (Agrometeorologicheskiye usloviya Povolzh'ya i effektivnost' meropriyatiy po bor'be s neblagopriyat' nymi gidrometeorologicheskimi yavleniyami), W72-02098	3F	Effect of Water Losses from Irrigation Canals on Groundwaters of the Aleysk Irrigation System (Vliyanie poter' vody iz orositel'nykh kanalov na gruntovyye vody Aleyskov orositel'noy sistemy), W72-02103	3F
A Biaxial Propeller Current-Meter System for Fixed-Mount Applications, W72-02038	7B	Problems in the Irrigation of the Kulunda Steppe (Nekotoryye voprosy orosheniya Kulundinskoy stepi), W72-02101	3F	Use and Abuse of Southwestern Rivers. The Pueblo Dweller, W72-02236	3F
A Stable Spar-Buoy Platform for Mounting Instrumentation, W72-02039	7B	Irrigation Planning 2: Choosing Optimal Acres Within a Season, W72-02130	6A	IRRIGATION WATER Potential Plant Pathogenic Fungi in Sewage and Polluted Water, W72-01809	5C
INTER-BASIN TRANSFERS Limitation on Diversion From the Watershed: Riparian Roadblock to Beneficial Use, W72-02149	6E	Secondary Economic Effects of Irrigation on the Colorado High Plains, W72-02136	6B	ISLANDS Analytical Solution for the Wind-Driven Circulation in a Lake Containing an Island, W72-02022	2H
INTERAGENCY COOPERATION Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1, W72-01979	6E	IRRIGATION CANALS Effect of Water Losses from Irrigation Canals on Groundwaters of the Aleysk Irrigation System (Vliyanie poter' vody iz orositel'nykh kanalov na gruntovyye vody Aleyskov orositel'noy sistemy), W72-02103	3F	Bosarge V. State (Outer Limits of Alabama's Territorial Jurisdiction), W72-02133	6E
INTERMITTENT STREAMS Periodical, Seasonal, or Intermittent Stream as a Watercourse, W72-02157	6E	IRRIGATION EFFICIENCY Lysimetric and Energy Balance Determination of Slatfence and Tree Windbreak Effects on Water Use Efficiency, W72-01748	2D	ISOLATION Microfungi in the Water, Mud, and Litter of a Cattail Marsh, W72-02112	5C
INTERSTATE COMMISSIONS Orsanco-1970, W72-02152	5G	Agrometeorological Conditions in the Volga Region and the Effectiveness of Measures to Combat Unfavorable Hydrometeorological Phenomena (Agrometeorologicheskiye usloviya Povolzh'ya i effektivnost' meropriyatiy po bor'be s neblagopriyat' nymi gidrometeorologicheskimi yavleniyami), W72-02098	3F	JETS Hydraulic Jump Assisted by Cross-Jet, W72-02020	8B
INTERSTATE COMPACTS Orsanco-1970, W72-02152	5G	IRRIGATION PRACTICES Sugar Beets in Arizona, W72-01742	3F	JOINT-SHEAR INDEX Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769	8E
INTERSTATE HIGHWAY Jacking a Sewer Under an Interstate Highway, W72-01856	5D	Characteristics and Pollution Problems of Irrigation Return Flow, W72-01984	5B	JUDICIAL DECISIONS Coastal Zone Management--The Tidelands: Legislative Apathy Vs. Judicial Concern, W72-02153	6E
INVESTIGATIONS Detection and Measurement of Stream Pollution, W72-01804	5C	Agrometeorological Conditions in the Volga Region and the Effectiveness of Measures to Combat Unfavorable Hydrometeorological Phenomena (Agrometeorologicheskiye usloviya Povolzh'ya i effektivnost' meropriyatiy po bor'be s neblagopriyat' nymi gidrometeorologicheskimi yavleniyami), W72-02098	3F	What Constitutes Natural Drainway or Watercourse for Flow of Surface Water, W72-02156	6E
IODINE RADIOISOTOPES Iodine and Algae in Sedimentary Rocks Associated with Iodine-Rich Brines, W72-02073	2K	IRRIGATION PRACTICES Sugar Beets in Arizona, W72-01742	3F	JUVENILE FISHES Temperature Requirements for Growth and Survival of Larval Ciscos (Coregonus Arted II), W72-01989	5C
ION EXCHANGE Long Term Movement of Water and Soil Salinity in the Weathering Zone of Arid Zone Sediments, W72-01753	2G	Characteristics and Pollution Problems of Irrigation Return Flow, W72-01984	5B	KARST Ground-Water Pollution Potential of a Landfill above the Water Table, W72-02081	5B
Colloid Flotation and Adsorbing Colloid Flotation, W72-02105	5D	Agrometeorological Conditions in the Volga Region and the Effectiveness of Measures to Combat Unfavorable Hydrometeorological Phenomena (Agrometeorologicheskiye usloviya Povolzh'ya i effektivnost' meropriyatiy po bor'be s neblagopriyat' nymi gidrometeorologicheskimi yavleniyami), W72-02098	3F	KENTUCKY Water Resources, W72-02144	6E
IONS Effect of Sulfate and Other Ions in Coagulation with Aluminum, W72-01869	5D	Use and Abuse of Southwestern Rivers. History of Man--The Spaniard, W72-02237	4A	KILAVEA (HAWAII) Some Aspects of the Geochemistry of F, Fe and Mn in Coastal Waters and in Fresh-Water Springs on the Southeast Coast of Hawaii, W72-01998	2K
IRAN The Chalus Valley and its Terraces: Studies in the History and Regionalization of the Central Elbur (North Iran) (Das Chalus-Tal und Seine Terrassen, Studien Zur Landschaftsgliederung und Landschaftsgeschichte des Mit tleren Elburs, (Nordiran),		IRRIGATION PROGRAMS Problems in the Irrigation of the Kulunda Steppe (Nekotoryye voprosy orosheniya Kulundinskoy stepi),		LA JUNTA (COLO) Improving Municipal Water Supplies in Colorado by Desalting,	

SUBJECT INDEX

LINEAR PROGRAMMING

W72-01839	3A	W72-02097	2H	W72-02008	4B
LACUSTRINE FILLS					
Saline Lake Basins of the Southern High Plains, W72-01752					
Present-day and Long-term Water and Salt Balance of Southern Seas of the USSR (Azov, Caspian and Aral) and Possible Changes in Their Hydrologic and Hydrochemical Regimes (Sovremennyy i perspektivnyy vodnyy i solevoy balansy i vozmozhnyye izmeneniya gidrologicheskogo i gidrokhimicheskogo rezhimov yuzhnykh morey SSSR (Azovskogo, Kaspiyskogo i Aralskogo), W72-02097					
2F					
LAKE BASINS					
Saline Lake Basins of the Southern High Plains, W72-01752					
Characterization of Inorganic Phosphate in Noncalcareous Lake Sediments, W72-02113					
2F					
LAKE MACBRIDE STATE PARK (IOWA)					
Determining the Demand and Economic Value for the Water-Based Outdoor Recreation Resources at Lake MacBride State Park in the Summer of 1970, W72-01980					
2H					
LAKE SAMMAMISH (WASH)					
Dissolved Oxygen Variations in Stratified Lakes, W72-01864					
Improving Municipal Water Supplies in Colorado by Desalting, W72-01839					
5C					
LAKE SHORES					
The Rights of the Public Versus the Rights of Riparian Owners to the Use of the Shore Between the Water's Edge and the High Water Mark on Lake Murray, W72-02150					
6E					
LAKES					
Control of Benthic Deposits in Lakes, W72-01699					
The Diversity of Pigments in Lake Sediments and Its Ecological Significance, W72-01784					
5C					
The Lake as a Microcosm, W72-01787					
5C					
Dissolved Oxygen Variations in Stratified Lakes, W72-01864					
5C					
Determining the Demand and Economic Value for the Water-Based Outdoor Recreation Resources at Lake MacBride State Park in the Summer of 1970, W72-01980					
6D					
Analytical Solution for the Wind-Driven Circulation in a Lake Containing an Island, W72-02022					
2H					
Permafrost-Hydrogeologic Regimen in Two Ice-Free Valleys, Antarctica, from Electrical Depth Sounding, W72-02030					
2C					
Observations of the Mud-Water Interface, W72-02052					
2H					
Organic-Inorganic Associations: Their Formation and Involvement in Nutrient Mobilization from the Sediments of Lakes, W72-02053					
2H					
Complex-Use Management of the Karasuk-Burla Lakes (Kompleksnoye khozyaystvennoye ispol'zovaniye Karasuksko-Burinskikh ozer), W72-02069					
4A					
A Preliminary Evaluation of Hydrologic Conditions of the Lakeland Ridge Area of Polk County, Florida, W72-02086					
4B					
A Statistical Theory of Water Level Fluctuations in Undrained Bodies of Water (Ostatisticheskoy teorii kolebaniy urovney vody v bessytochnykh vodoyemakh),					
2H					
Present-day and Long-term Water and Salt Balance of Southern Seas of the USSR (Azov, Caspian and Aral) and Possible Changes in Their Hydrologic and Hydrochemical Regimes (Sovremennyy i perspektivnyy vodnyy i solevoy balansy i vozmozhnyye izmeneniya gidrologicheskogo i gidrokhimicheskogo rezhimov yuzhnykh morey SSSR (Azovskogo, Kaspiyskogo i Aralskogo), W72-02097					
2H					
Characterization of Inorganic Phosphate in Noncalcareous Lake Sediments, W72-02113					
2H					
LAMAR (COLO)					
Improving Municipal Water Supplies in Colorado by Desalting, W72-01839					
3A					
LAMINAR FLOW					
Final Report on Control of Concentration Polarization in Reverse Osmosis Desalination of Water, W72-02107					
3A					
LAND DISPOSAL					
Agricultural Utilization of Sewage Effluent and Sludge, an Annotated Bibliography, W72-02104					
5G					
LAND MANAGEMENT					
A Methodology Study to Develop Evaluation Criteria for Wild and Scenic Rivers: Landowner Perception of Recreationist Associated Conflicts in the Salmon-Little Salmon River Corridor of Idaho, W72-01746					
6B					
LAND RECLAMATION					
Problems in the Irrigation of the Kulunda Steppes (Nekotorye voprosy orosheniya Kulundinskoy stepi), W72-02101					
3F					
LAND TENURE					
Hill City Compress Co. V. West Kentucky Coal Co. (Common Boundary of Louisiana and Mississippi), W72-02195					
6E					
LANDFILLS					
Ground-Water Pollution Potential of a Landfill above the Water Table, W72-02081					
5B					
LANDSLIDES					
A Method of Monitoring Mudflow Movements, W72-01722					
2J					
LAS ANIMAS (COLO)					
Improving Municipal Water Supplies in Colorado by Desalting, W72-01839					
3A					
LEAD					
Water Geochemistry of Mining and Milling Retention in the 'New Lead Belt' of Southeast Missouri, W72-01692					
5B					
LEADERSHIP					
Environment Crises, W72-01694					
6B					
LEAST SQUARES METHOD					
An Algorithm for Least Squares Analysis of Drawdown in Observation Wells,					
LINEAR PROGRAMMING					
Optimization in Municipal Water Supply System Design, W72-02125					
6A					
Mathematical Foundations for Design: Civil Engineering Systems, W72-02127					
6A					
Irrigation Planning 2: Choosing Optimal Acres Within a Season, W72-02130					
6A					
The Simulation and Optimization of a Single Effect Multi-Stage Flash Desalination Plant,					

SUBJECT INDEX

LITTORAL

W72-02131

6A

LITTORAL

The Rights of the Public Versus the Rights of Riparian Owners to the Use of the Shore Between the Water's Edge and the High Water Mark on Lake Murray,
W72-02150

6E

LITTORAL DRIFT

A Class of Probability Models for Littoral Drift,
W72-02121

6A

LOCATING

Standard Utilities Location.

W72-01821

8A

LOTIC ENVIRONMENT

Predicting Variations in Energy Flow Through a Semi-Controlled Lotic Ecosystem,
W72-01701

2I

LOUISIANA

Grand Isle: A Barrier Island in the Gulf of Mexico,
W72-01718

2J

Hill City Compress Co. V. West Kentucky Coal Co. (Common Boundary of Louisiana and Mississippi).
W72-02195

6E

LOW-FLOW AUGMENTATION

Model for Flow Augmentation Analysis-An Overview,
W72-01874

5G

LOWER COLORADO RIVER (SALTON SEA AREA)

Salinity of Surface Water in the Lower Colorado River - Salton Sea Area,
W72-02074

2K

LUMBERING

Effect of Siltation, Resulting from Improper Logging, on the Bottom Fauna of a Small Trout Stream in the Southern Appalachians,
W72-01802

5C

LYSIMETER

Seasonal Effects on Soil Drying After Irrigation,
W72-02217

2D

LYSIMETERS

Lysimetric and Energy Balance Determination of Slatfence and Tree Windbreak Effects on Water Use Efficiency,
W72-01748

2D

MAPPING

Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States,
W72-02210

2B

MARYLAND

Transmissivity Tracts in the Coastal Plain Aquifers of Maryland,
W72-01730

2F

Petroleum Contamination of Ground Water in Maryland,
W72-02080

5B

MASS BALANCE (GLACIERS)

Corrective Terms in the Glaciological Balance,
W72-01715

2C

MASS TRANSFER

Influences of Exposure on Pan Evaporation in a Mountainous Area,

MASS WASTING

A Method of Monitoring Mudflow Movements,
W72-01722

2J

MASSACHUSETTS

Hydrologic Factors in the Determination of Watershed Yields,
W72-01700

2A

Observations on Short-Period Internal Waves in Massachusetts Bay,
W72-02035

2L

MATERIALS TESTS

Field Evaluation of Heavy-Walled Pressure Vessels Using Acoustic Emission Analysis,
W72-01776

8G

MATHEMATICAL MODEL

Application of Mathematical Models to the Eutrophication Process,
W72-01991

5B

MATHEMATICAL MODELS

Oxygen Sag and Stream Self-Purification,
W72-01785

5C

MATHEMATICAL MODELS

Numerical Solution of Filtration Equations,
W72-01841

5D

FINITE-DIFFERENCE CONVECTION ERRORS

W72-01858

7C

Theoretical Evaluation of Filter Modeling Experiments,
W72-01859

5E

Dissolved Oxygen Variations in Stratified Lakes,
W72-01864

5C

Height of Sand Dunes in Open Channel Flows,
W72-02021

2J

Determination of Nonlinear Functional Response Functions in Rainfall-Runoff Processes,
W72-02116

2A

A Class of Probability Models for Littoral Drift,
W72-02121

6A

Optimization in Municipal Water Supply System Design,
W72-02125

6A

Mathematical Foundations for Design: Civil Engineering Systems,
W72-02127

6A

The Simulation and Optimization of a Single Effect Multi-Stage Flash Desalination Plant,
W72-02131

6A

MATHEMATICAL STUDIES

Augmenting Annual Runoff Records Using Tree-Ring Data,
W72-02213

2E

Uncertainties in Digital-Computer Modeling of Groundwater Basins,
W72-02215

2F

MEASUREMENT

Biological Assays and Water Quality in Minnesota,
W72-01783

5C

Detection and Measurement of Stream Pollution,

W72-01781

W72-01804

Determination of the Three-Dimensional Velocity Field in a Glacier,
W72-02147

2C

Field Measurements of Soil-Water Content and Soil-Water Pressure,
W72-02222

2G

MEDITERRANEAN

Dispersal Patterns of Clay Minerals in the Sediments of the Eastern Mediterranean Sea,
W72-01999

2J

MELT WATER

Hydrologic Characterization of Forested Watersheds in Arizona,
W72-01702

2C

MEMBRANE COEFFICIENTS

Improved Membranes for Reverse Osmosis,
W72-01833

3A

MEMBRANE PROCESSES

Field Evaluation of Forced-Flow Electrodialysis,
W72-01836

3A

In-Situ Regenerable Membranes for Reverse Osmosis,
W72-01837

3A

Membranes for Desalination by Reverse Osmosis,
W72-02046

3A

MEMBRANE TRANSPORT

Improved Membranes for Reverse Osmosis,
W72-01833

3A

MEMBRANES

Improved Membranes for Reverse Osmosis,
W72-01833

3A

The Design, Fabrication and Testing of a 1000 Gallon Per Day Tubular Reverse Osmosis Pilot Plant,
W72-02045

3A

Large Reverse Osmosis System Technology and Module Development,
W72-02047

3A

Development of New and Improved Cellulose Ester Reverse Osmosis Membranes,
W72-02049

3A

New and Improved Cellulose Ester Membranes,
W72-02111

3A

MERCURY

Mercury Pollution: Michigan's Action Program,
W72-01995

5B

METABOLISM

Kinetics of the Steady State Bacterial Culture IV. Transfer Rates,
W72-01865

5D

METAL CHELATES

The Radiochromatographic Analysis of Fresh Water Resources,
W72-01981

2K

METALS

The Radiochromatographic Analysis of Fresh Water Resources,

SUBJECT INDEX

				MONETARY BENEFITS
W72-01981	2K	W72-02024	5A	5B
METEOROLOGICAL DATA				
Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere, W72-01741				2B
Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia, W72-02025				2B
Agrometeorological Conditions in the Volga Region and the Effectiveness of Measures to Combat Unfavorable Hydrometeorological Phenomena (Agrometeorologicheskiye usloviya Povolzh'ya i effektivnost' meropriyatiy po bor'be s neblagopriyatnymi gidrometeorologicheskimi yavleniyami), W72-02098				3F
METEOROLOGY				
Agrometeorological Conditions in the Volga Region and the Effectiveness of Measures to Combat Unfavorable Hydrometeorological Phenomena (Agrometeorologicheskiye usloviya Povolzh'ya i effektivnost' meropriyatiy po bor'be s neblagopriyatnymi gidrometeorologicheskimi yavleniyami), W72-02098				3F
Estimated Return Periods for Short-Duration Precipitation in Utah, W72-02026				2B
MEXICO				
Geothermics in North America: Present and Future, W72-01756				4B
MICHIGAN				
Mercury Pollution: Michigan's Action Program, W72-01995				5B
Natural Relationships of Indicator and Pathogenic Bacteria in Stream Waters, W72-01996				5B
Validation of Political Simulation Models - Water Resource Projects, W72-02129				6A
MICROBIAL ADAPTATION				
Selection and Adaptation of Microorganisms in Waste Treatment, W72-01820				5D
MICROFUNGI				
Microfungi in the Water, Mud, and Litter of a Cattail Marsh, W72-02112				5C
MICROORGANISMS				
The Chemistry and Biology of Milk Waste Disposal, W72-01816				5D
Selection and Adaptation of Microorganisms in Waste Treatment, W72-01820				5D
MICROSCOPY				
An Improved Method for Determining Ice Fabrics, W72-02002				2C
MICROWAVES				
Microwave Radiometric Detection of Oil Slicks,				
MILK WASTES				
The Chemistry and Biology of Milk Waste Disposal, W72-01816				5D
MILWAUKEE (WISC)				
Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1, W72-01979				6E
MINE WASTES				
Water Geochemistry of Mining and Milling Retention in the 'New Lead Belt' of Southeast Missouri, W72-01692				5B
MINE WATER				
Water Geochemistry of Mining and Milling Retention in the 'New Lead Belt' of Southeast Missouri, W72-01692				5B
MINERAL WATER				
A Survey of Saline Ground Water as a Mineral Resource, W72-01754				2K
MINERAL WATERS				
Sensory Examination of Mineralized, Chlorinated Waters, W72-01868				5F
MINERALOGY				
Heavy Minerals of Northern Sand Key, Pinellas County, Florida, W72-01732				2J
MINIMUM DESIGN STANDARDS				
Minimum Design Standards for Community Water Supply Systems (Existing standard-FHA 4517.1) (Draft environmental statement). W72-01822				5F
MINNESOTA				
Biological Assays and Water Quality in Minnesota, W72-01783				5C
Ground Water for Irrigation in the Brooten-Belgrade Area, West-Central Minnesota, W72-02071				4B
Nitrogen Balance For a 23 Square Mile Minnesota Watershed, W72-02216				2K
MISSISSIPPI				
Hill City Compress Co. V. West Kentucky Coal Co. (Common Boundary of Louisiana and Mississippi). W72-02195				6E
MISSISSIPPI RIVER				
Hill City Compress Co. V. West Kentucky Coal Co. (Common Boundary of Louisiana and Mississippi). W72-02195				6E
MIXED CROPPING				
Against Monoculture, W72-01762				3F
MIXING				
Discontinuities in Stratified Flows, W72-01723				2E
Inka Aeration at Hazleton, Pennsylvania, W72-01844				5D
Cesium-137 in the North Atlantic Measured by Selective Absorption in Situ,				
MONETARY BENEFITS				
Management of Artificial Recharge Wells for Groundwater Quality Control, W72-02228				5G
MODEL STUDIES				
Predicting Variations in Energy Flow Through a Semi-Controlled Lotic Ecosystem, W72-01701				2I
Statistical Inference on Streamflow Processes with Markovian Characteristics, W72-01704				2E
Stream Life and the Pollution Environment, W72-01803				5C
Model Studies of Outfall Systems for Desalination Plants (Part I - Flume Study), W72-01838				5E
A Critical Review of Currently Available Hydrologic Models for Analysis of Urban Stormwater Runoff, W72-01978				2A
Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniya vesennego stoka i yeye realizatsiya diya prognoza gidrografa), W72-02096				2E
Uncertainties in Digital-Computer Modeling of Groundwater Basins, W72-02215				2F
A Stochastic Analysis of Flows on Rillito Creek, W72-02224				2E
Collective Utility: A Systems Approach for the Utilization of Water Resources, W72-02232				4B
Comparison of Water Pricing Structures from a Collective Utility Viewpoint, W72-02233				6C
MOISTURE AVAILABILITY				
Soil Moisture Survey, 1970-1971. W72-01744				2G
MOISTURE CONTENT				
Drying Rates of Birdfoot Trefoil Seed, W72-02089				3F
MOISTURE STRESS				
Ecophysiological Studies on Plants in Arid and Semiarid Regions in Western Australia. IV. Comparison of the Field Physiology of the Host, Acacia Grasbyi and its Hemiparasite, Amyema Nestor Under Optimal and Stress Conditions, W72-01740				2I
Psychrometric Determination of Water Potential of Desert Plants, W72-01761				2I
A Critique of the Concept of Growing Season, W72-02211				3F
MOLECULAR STRUCTURE				
Solute Properties of Water--Part II, W72-02110				1A
MONETARY BENEFITS				
Inertial Forecast of Water Storage in Soil and its Economic Effectiveness (Inertsionnyy prognoz pochvennykh vlagozapasov i yego ekonomicheskaya effektivnost'),				

SUBJECT INDEX

MONITORING

W72-02095	2G	W72-02029	7B	W72-01693	5A																																																		
MONITORING																																																							
A Method of Monitoring Mudflow Movements, W72-01722	2J	Phytoplanktonic Nitrogen as an Index of Cultural Eutrophication, W72-01780				5C																																																	
MOSITURE STRESS																																																							
Drought Influence on Physiological Processes and Subsequent Growth, W72-01758	3F	Chemistry of Nitrogen and Phosphorus in Water, W72-01867				5C																																																	
MOVEMENT																																																							
On the Temperature Profile and the Age Profile in the Central Part of Cold Ice Sheets, W72-01705	2C	Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02159				5B																																																	
Permeability, Brine Content and Temperature of Temperate Ice, W72-01706	2C	Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02160				5B																																																	
Shear Stress at the Base of a Rigidly Cirque Glacier, W72-01707	2C	NITROGEN CYCLE																																																					
The Possible Future Behaviour of Berendon Glacier, Canada - A Further Study, W72-01709	2C	Nitrogen Balance For a 23 Square Mile Minnesota Watershed, W72-02216				2K																																																	
Determination of the Three-Dimensional Velocity Field in a Glacier, W72-02147	2C	NON-PERENNIAL STREAMS																																																					
MUD-WATER INTERFACES																																																							
Observations of the Mud-Water Interface, W72-02052	2H	Periodical, Seasonal, or Intermittent Stream as a Watercourse, W72-02157				6E																																																	
Oxidation-Reduction Determinations at The Mud-Water Interface, W72-02054	2H	NON-PIGMENTED FLAGELLATES																																																					
MUDFLOWS																																																							
A Method of Monitoring Mudflow Movements, W72-01722	2J	Suggested Classification of Algae and Protozoa in Sanitary Science, W72-01798				5C																																																	
MULCHING																																																							
Mulching Techniques for Arid Lands Vegetable Production, W72-02221	3F	NONCALCAREOUS SEDIMENTS																																																					
MULTIRESERVOIR ANALYSIS																																																							
Multireservoir Analysis Techniques in Water Quantity Studies, W72-02057	4A	Characterization of Inorganic Phosphate in Noncalcareous Lake Sediments, W72-02113				2H																																																	
MUNICIPAL WASTES																																																							
The Prevention of Pollution in Estuaries, W72-01883	5G	NONDESTRUCTIVE TESTS																																																					
MUNICIPAL WATER																																																							
Inventory and Problem Delineation, Phase I Report, Regional Water Supply and Wastewater Disposal Study, W72-01830	6D	Field Evaluation of Heavy-Walled Pressure Vessels Using Acoustic Emission Analysis, W72-01776				8G																																																	
Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1, W72-01979	6E	NORTH CAROLINA																																																					
Comparison of Water Pricing Structures from a Collective Utility Viewpoint, W72-02233	6C	NEW YORK						NEW YORK CITY						NEW YORK CITY (NY)						NEWARK BAY						NITRATES						NITROGEN						OBSERVATION WELLS						OCEAN CIRCULATION						OCEAN CURRENTS					
NEW YORK																																																							
NEW YORK CITY																																																							
NEW YORK CITY (NY)																																																							
NEWARK BAY																																																							
NITRATES																																																							
NITROGEN																																																							
OBSERVATION WELLS																																																							
OCEAN CIRCULATION																																																							
OCEAN CURRENTS																																																							

SUBJECT INDEX

PACIFIC OCEAN

W72-02034	2E	W72-02036	5B	W72-01695	1A
Pacific Bottom Water: Penetration Around Hawaii,	East	OILY WATER		OSO CREEK BASIN (NUCES COUNTY	
W72-02040	2E	Microwave Radiometric Detection of Oil Slicks,		OSO Creek Technical Assistance Study: Preliminary Study on the Problems and Opportunities for Development of OSO Creek and OSO Bay.	
Water Exchange at the Mouth of the Gulf of California,	2E	W72-02024	5A	W72-02028	6B
W72-02041		Distribution of Suspended Oil Particles Following the Grounding of the Tanker Arrow,		OUTLETS	
OCEAN WAVES		W72-02036	5B	Shapes of Grit Chambers to Achieve Certain Velocity-Head Relations with given Shapes of Outlet Weirs,	
Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements,		Petroleum Contamination of Ground Water in Maryland,		W72-01729	3B
W72-02014	7B	W72-02080	5B	Model Studies of Outfall Systems for Desalination Plants (Part I - Flume Study),	
Spatial Structure of Inertial-Period Motions in a Two-Layered Sea, Based on Observations,	2E	W72-02055	2F	W72-01838	5E
W72-02033		OKLAHOMA		OVERCURRENT	
OCEANOGRAPHIC INSTRUMENTS		Concentration Gradients in Aquifers,		A Study of Reinsertion Transient Voltages for Series Capacitors on USBR Glen Canyon - Flagstaff 345 KV Lines,	
A Stable Spar-Buoy Platform for Mounting Instrumentation,		W72-02073	2K	W72-01775	8C
W72-02039	7B	OPERATIONS RESEARCH		OVERVOLTAGE	
OCEANOGRAPHY		Iodine and Algae in Sedimentary Rocks Associated with Iodine-Rich Brines,		A Study of Reinsertion Transient Voltages for Series Capacitors on USBR Glen Canyon - Flagstaff 345 KV Lines,	
A Stable Spar-Buoy Platform for Mounting Instrumentation,		W72-02127	6A	W72-01775	8C
W72-02039	7B	Digital Simulation of an Existing Water Resources System,		OXIDATION	
Hydrologic Computational Methods for Marine Hydraulic Engineering Construction (Metody morskikh hidrologicheskikh raschetov dlya tsley gidrotekhnicheskogo stroitel'stva),		W72-02132	6A	Gas-Phase Catalytic Oxidation of Phenol in Dilute Concentrations with Water Vapor,	
W72-02094	2L	OPTIMIZATION		W72-02050	5D
ODOR		Optimization in Municipal Water Supply System Design,		OXIDATION LAGOONS	
Chemical Composition of Algae and its Relationship to Taste and Odor,		W72-02125	6A	Biological Treatment of Beef Animal Wastes,	
W72-01812	5A	Mathematical Foundations for Design: Civil Engineering Systems,		W72-01777	5D
Industrial Wastes as a Source of Tastes and Odors in Water Supplies,		W72-02127	6A	Biological Factors in Treatment of Raw Sewage in Artificial Ponds,	
W72-01815	5C	Irrigation Planning 2: Choosing Optimal Acreages Within a Season,		W72-01818	5D
ODOROPHORE GROUPS		W72-02130	6A	OXIDATION-REDUCTION POTENTIAL	
Industrial Wastes as a Source of Tastes and Odors in Water Supplies,		The Simulation and Optimization of a Single Effect Multi-Stage Flash Desalination Plant,		Observations of the Mud-Water Interface,	
W72-01815	5C	W72-02131	6A	W72-02052	2H
OGALLALA AQUIFER		Collective Utility: A Systems Approach for the Utilization of Water Resources,		Oxidation-Reduction Determinations at The Mud-Water Interface,	
Recharging the Ogallala Formation Using Shallow Holes,		W72-02232	4B	W72-02054	2H
W72-02227		ORGANIC MATTER		OXYGEN REQUIREMENTS	
OHIO		Organic-Inorganic Associations: Their Formation and Involvement in Nutrient Mobilization from the Sediments of Lakes,		Oxygen Diffusion Through a Pure Culture Floc of Zoogloea Ramigera,	
Snow in Ohio,		W72-02053	2H	W72-01851	5D
W72-02027		ORTHOPHOSPHATES		Oxygen Requirements of Some Marine and Anadromous Fishes, with Particular Reference to Problems of Measurement,	
OHIO RIVER		Removal of Orthophosphates From Aqueous Solutions with Activated Alumina,		W72-01875	5C
Orsanco-1970.		W72-01847	5D	Aerobic Decomposition of Algae,	
W72-02152	5G	OSCILLATION ERRORS		W72-01881	5D
OHIO RIVER BASIN		Finite-Difference Convection Errors,		OXYGEN TRANSFER EFFICIENCY	
Sewage, Algae and Fish,		W72-01858	7C	Inka Aeration at Hazleton, Pennsylvania,	
W72-01788	5C	OSMOSIS		W72-01844	5D
OIL		Final Report on Control of Concentration Polarization in Reverse Osmosis Desalination of Water,		OXYGEN TRANSFER RATES	
Characterization and Identification of Spilled Residual Fuel Oils by Gas Chromatography and Infrared Spectrophotometry,		W72-02107	3A	Aerator Performance in Natural Streams,	
W72-02196	5A	OSMOTIC COEFFICIENTS		W72-01842	5G
OIL SPILLS		Isotope Effect on the Thermodynamic Activity of Water,		PACIFIC OCEAN	
Microwave Radiometric Detection of Oil Slicks,				New Evidence of the Equatorial Undercurrent East of the Galapagos Islands,	
W72-02024	5A			W72-02034	2E
Distribution of Suspended Oil Particles Following the Grounding of the Tanker Arrow,				Pacific Bottom Water: Penetration East Around Hawaii,	

SUBJECT INDEX

PACIFIC OCEAN

W72-02040	2E	W72-01719	2J	W72-01824	5D
The Origin of Metal-Bearing Submarine Hydrothermal Solutions,		PEDOGENESIS		PHOSPHATE	
W72-02044	2K	Some Geographic Implications of Water-Repellent Soils,		Effects of Recent and Past Phosphate Fertilization on the Amount of Phosphorus Percolating Through Soil Profiles into Subsurface Waters,	
		W72-01745	2G	W72-01691	2G
PACIFICATION		PENNSYLVANIA		PHOSPHATE-FREE DETERGENTS	
Stabilization of Product Water From Seawater Distillation Plants,		Ground-Water Pollution Potential of a Landfill above the Water Table,		Development of Phosphate-Free Home Laundry Detergents,	
W72-01835	3A	W72-02081	5B	W72-01986	5B
PALEICLIMATOLOGY		Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks in Central Pennsylvania,		PHOSPHATES	
Terraces and Pediment-Terraces in the Southwest: An Interpretation,		W72-02115	4B	Removal of Orthophosphates From Aqueous Solutions with Activated Alumina,	
W72-01719	2J	PERMAFROST		W72-01847	5D
PARAQUAT		Permafrost Occurrence in the Front Range, Colorado Rocky Mountains, U.S.A.,		Virus Inactivation During Phosphate Precipitation,	
Movement and Adsorption of Pesticides in Sterilized Soil Columns,		W72-01712	2C	W72-01852	5D
W72-01697	5B	Permafrost-Hydrogeologic Regimen in Two Ice-Free Valleys, Antarctica, from Electrical Depth Sounding,		Development of Phosphate-Free Home Laundry Detergents,	
PARTICLE SIZE		W72-02030	2C	W72-01986	5B
Distribution of Suspended Oil Particles Following the Grounding of the Tanker Arrow,		PERMEABILITY		Characterization of Inorganic Phosphate in Noncalcareous Lake Sediments,	
W72-02036	5B	Permeability, Brine Content and Temperature of Temperate Ice,		W72-02113	2H
Optical Fourier Transform Technique for Measuring Sediment Concentration,		W72-01706	2C	PHOSPHOROUS FIXATION	
W72-02158	2J	Improved Membranes for Reverse Osmosis,		Effects of Recent and Past Phosphate Fertilization on the Amount of Phosphorus Percolating Through Soil Profiles into Subsurface Waters,	
PASSAIC RIVER		W72-01833	3A	W72-01691	2G
Navigation Project, Newark Bay, Hackensack and Passaic Rivers, New Jersey, (Final Environmental Statement).		PERMSELECTIVE MEMBRANES		PHOSPHORUS	
W72-01826	8A	Coastal Zone Management-The Tidelands: Legislative Apathy Vs. Judicial Concern,		Effects of Recent and Past Phosphate Fertilization on the Amount of Phosphorus Percolating Through Soil Profiles into Subsurface Waters,	
PASSAIC RIVER (NJ)		W72-02153	6E	W72-01691	2G
Aerator Performance in Natural Streams,		New and Improved Cellulose Ester Membranes,		Chemistry of Nitrogen and Phosphorus in Water.	
W72-01842	5G	W72-02111	3A	W72-01867	5C
PATH OF POLLUTANTS		PERT NETWORKS		PHOTOSYNTHESIS	
Predicting Effects of Dead Zones on Stream Mixing,		Progress in Developing Forest Management Guidelines for Increasing Snowpack Water Yields,		Ecophysiological Studies on Plants in Arid and Semiarid Regions in Western Australia. IV. Comparison of the Field Physiology of the Host, <i>Acacia Grasbyi</i> and its Hemiparasite, <i>Amyema Nestor</i> Under Optimal and Stress Conditions,	
W72-01853	5B	W72-02230	4A	W72-01740	2I
Relationship Between Escherichia Coli, Type I and Enterococci in Water,		PESTICIDE REMOVAL		A Critique of the Concept of Growing Season,	
W72-01854	5B	Movement and Adsorption of Pesticides in Sterilized Soil Columns,		W72-02211	3F
Subsurface Distribution of Nitrates Below Commercial Cattle Feedlots, Texas High Plains,		W72-01697	5B	PHOTOSYNTHETIC OXYGEN	
W72-02003	5B	Sorption and Desorption of Chlorinated Hydrocarbon Pesticides in Aquatic Sediment Minerals,		Biological Factors in Treatment of Raw Sewage in Artificial Ponds,	
Distribution of Suspended Oil Particles Following the Grounding of the Tanker Arrow,		W72-01779	5B	W72-01818	5D
W72-02036	5B	Pesticide contamination of a Shallow Bored Well in the Southeastern Coastal Plains,		PHYSICAL PROPERTIES	
Pesticide contamination of a Shallow Bored Well in the Southeastern Coastal Plains,		W72-02078	5B	Thermodynamic Properties of Water to 1,000C and 10,000 Bars,	
W72-02078	5B	PETROFABRICS		W72-02048	1A
Gasoline Pollution of a Ground-Water Reservoir -- A Case History,		An Improved Method for Determining Ice Fabrics,		PHYSIOLOGICAL ECOLOGY	
W72-02079	5B	W72-02002	2C	Ecophysiological Studies on Plants in Arid and Semiarid Regions in Western Australia. IV. Comparison of the Field Physiology of the Host, <i>Acacia Grasbyi</i> and its Hemiparasite, <i>Amyema Nestor</i> Under Optimal and Stress Conditions,	
Plutonium-239 in and Over the Atlantic Ocean,		PHENOLS		W72-01740	2I
W72-02083	5B	Gas-Phase Catalytic Oxidation of Phenol in Dilute Concentrations with Water Vapor,		PHYTOBENTHOS	
PATHOGENIC FUNGI		W72-02050	5D	Microfungi in the Water, Mud, and Litter of a Cattail Marsh,	
Potential Plant Pathogenic Fungi in Sewage and Polluted Water,		PHILADELPHIA (PA)			
W72-01809	5C	Toward Computer Control of Wastewater Treatment,			
PAVED CHANNELS					
Low Cost Storm Drainage With Paved Channels,					
W72-01880	4A				
PEDIMENTS					
Terraces and Pediment-Terraces in the Southwest: An Interpretation,					

SUBJECT INDEX

PRE-TREATMENT (WATER)

W72-02112	5C	W72-01757	3F	W72-01996	5B
PHYTOPLANKTON					
Microfungi in the Water, Mud, and Litter of a Cattail Marsh,		Ecophysiological Studies on Plants in Arid and Semiarid Regions in Western Australia. IV. Com- parison of the Field Physiology of the Host, Acacia Grasbyi and its Hemiparasite, Amyema Nestor Under Optimal and Stress Conditions,			
W72-02112	5C	W72-01740	2I	W72-01825	6D
PIEDMONT TRIAD REGION					
Inventory and Problem Delineation, Phase I Report, Regional Water Supply and Wastewater Disposal Study.		Complex-Use Management of the Karasuk- Buria Lakes (Kompleksnoye khozyaystvennoye ispol'zovaniye Karasuksko-Burinskikh ozer),			
W72-01830	6D	W72-02069	4A		
PIGMENTED FLAGELLATES					
Suggested Classification of Algae and Protozoa in Sanitary Science,		On the Economic Impact of Large Diversions of Snake River Waters,			
W72-01798	5C	W72-02124	6D		
PIGMENTS					
The Diversity of Pigments in Lake Sediments and Its Ecological Significance,		Economics and Politics in Water Pollution Con- trol,			
W72-01784	5C	W72-02135	5G		
PILOT PLANTS					
The Design, Fabrication and Testing of a 1000 Gallon Per Day Tubular Reverse Osmosis Pilot Plant,		Thermodynamics of Environmental Degrada- tion,			
W72-02045	3A	W72-02137	5G		
Large Reverse Osmosis System Technology and Module Development,		POLLUTION INDEX			
W72-02047	3A	Phytoplankton Nitrogen as an Index of Cul- tural Eutrophication,			
PLANKTON					
A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use,		W72-01780	5C		
W72-01735	5C	POLYELECTROLYTES			
The Plankton of the Sangamon River in the Summer of 1929,		Virus Removal by Coagulation with Polyelec- trolytes,			
W72-01795	5C	W72-01886	5F		
PLANNING					
Water Quality Management Planning in South Carolina: A Planning Manual.		POLYMER FILTERING AGENTS			
W72-01825	6D	The De-Watering of Digested Sludge Using Synthetic Filtering Agents,			
Navigation Project, Newark Bay, Hackensack and Passaic Rivers, New Jersey, (Final Environ- mental Statement).		W72-01846	5E		
W72-01826	8A	POLYMER MEMBRANES			
'S' Street Channel Improvements, Needles, San Bernardino County, California, Environmen- tal Statement (Environmental statement).		Improved Membranes for Reverse Osmosis,			
W72-01828	8A	W72-01833	3A		
Inventory and Problem Delineation, Phase I Report, Regional Water Supply and Wastewater Disposal Study.		PONDEROSA PINE TREES			
W72-01830	6D	Hydrologic Characterization of Forested Watersheds in Arizona,			
OSO Creek Technical Assistance Study: Preliminary Study on the Problems and Opportu- nities for Development of OSO Creek and OSO Bay.		W72-01702	2C		
W72-02028	6B	PONDS			
POLLUTANT IDENTIFICATION					
Microwave Radiometric Detection of Oil Slacks,		Oxidation-Reduction Determinations at The Mud-Water Interface,			
W72-02024	5A	W72-02054	2H		
Comparison of Plant Water Quality to Proposed Water Quality Standard,		POROUS MEDIA			
W72-02082	5F	Dynamic Fluid Loss During Viscous Flow Through a Porous Vertical Slot,			
Can We Breed for Drought Resistance,		W72-02060	8B		
W72-01757	3F	POTABLE WATER			
Drought Influence on Germination and Seedling Emergence,		Water Pollution, Its Effect on Public Health,			
W72-01739	3F	W72-01808	5C		
Can We Breed for Drought Resistance,		Stabilization of Product Water From Seawater Distillation Plants,			
		W72-01835	3A		
PLANT BREEDING					
PLANT GROWTH					
POLLUTANT IDENTIFICATIONS					
POTENTIAL EVAPORATION					
POTENTIAL EVAPOTRANSPIRATION					
PRE-COLUMBIAN TECHNOLOGY					
PRE-TREATMENT (WATER)					

SUBJECT INDEX

PRECIPITATION (ATMOSPHERIC)

W72-02046	3A	W72-01823	5D	W72-02094	2L
PRECIPITATION (ATMOSPHERIC)			1970 Literature Review, Administration:		
Soil Moisture Survey, 1970-1971.		Can We Breed for Drought Resistance, W72-01757	3F	Economics, W72-02140	6B
W72-01744	2G				
Investigation of the Effects of Urbanization on Precipitation Type, Frequency, Areal and Temporal Distribution, W72-01982	2B	PROJECT FEASIBILITY		PULP AND PAPER INDUSTRIES	
Estimated Return Periods for Short-Duration Precipitation in Utah, W72-02026	2B	Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestestvennyye usloviya uvlazhneniya territorii Okskogo basseyna i perspektivnye gidromelioratsii), W72-02063	4A	Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notamment Des Fabriques de Pate a Papier et d'Huile Vegetale Hydrogenee), W72-02208	5B
Characteristics of Atmospheric Precipitation in the Southeastern Part of the West Siberian Plain (Nekotoryye osobennosti atmosfernogo uvlazhneniya na yugo-vostoke Zapadno-Sibirskoy ravniny), W72-02100	2B	PROJECT PLANNING			
Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States, W72-02210	2B	Progress in Developing Forest Management Guidelines for Increasing Snowpack Water Yields, W72-02230	4A	PULP WASTES	
PRECIPITATION EXCESS		PROTECTION (ELECTRICAL)		Pilot Mechanical Aeration Studies of the Jackson River in Covington, West Virginia, W72-01845	5G
A Critical Review of Currently Available Hydrologic Models for Analysis of Urban Stormwater Runoff, W72-01978	2A	A Study of Reinsertion Transient Voltages for Series Capacitors on USBR Glen Canyon - Flagstaff 345 KV Lines, W72-01775	8C	Measurement, Control and Changes in Foaming Characteristics of Pulping Wastes During Biological Treatment, W72-01877	5D
PRECIPITATION MODIFICATION		PROTOZOA		Biological Treatment of Strong Industrial Waste from a Fiberboard Factory, W72-01885	5D
Investigation of the Effects of Urbanization on Precipitation Type, Frequency, Areal and Temporal Distribution, W72-01982	2B	Suggested Classification of Algae and Protozoa in Sanitary Science, W72-01798	5C	Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notamment Des Fabriques de Pate a Papier et d'Huile Vegetale Hydrogenee), W72-02208	5B
PRECIPITATION RETURN PERIODS (UTAH)		Protozoa and Activated Sludge, W72-01817	5D	PULPWASTES	
Estimated Return Periods for Short-Duration Precipitation in Utah, W72-02026	2B	A Partial Checklist of Florida Fresh-Water Algae and Protozoa with Reference to McCloud and Cue Lakes, W72-01993	5A	Effect of Filter Cloth Structure on Flow Resistance, Bleeding, Blinding and Plant Performance, W72-01878	5D
PREFERENCE (WATER RIGHTS)		PROVENANCE		PUMP TURBINES	
Concepts Used as Economic Criteria for a System of Water Rights, W72-02148	6E	Basement Ice, Ward Hunt Ice Shelf, Ellesmere Island, Canada, W72-01710	2C	Pumped Storage: State-of-the-Art. W72-01771	8C
PRESSURE VESSELS		Dispersal Patterns of Clay Minerals in the Sediments of the Eastern Mediterranean Sea, W72-01999	2J	PUMPED STORAGE	
Field Evaluation of Heavy-Walled Pressure Vessels Using Acoustic Emission Analysis, W72-01776	8G	PSEUDOMONAS FLUORESCENS		Pumped Storage: State-of-the-Art. W72-01771	8C
PRIMARY PRODUCTIVITY		Kinetics of the Steady State Bacterial Culture IV. Transfer Rates, W72-01865	5D	PUMPING	
Eutrophication: Small Florida Lakes as Models to Study the Process, W72-01990	5B	PUBLIC HEALTH		Concentration Gradients in Aquifers, W72-02055	2F
PRINCIPAL COMPONENTS ANALYSIS		Water Pollution, Its Effect on Public Health, W72-01808	5C	Test of the Stroebel Spring - A Supplementary Study of the Fort Carson Expansion Project, Civil Action No. 8920, Tract No. 202, El Paso County, Colorado, W72-02088	4B
Augmenting Annual Runoff Records Using Tree-Ring Data, W72-02213	2E	Insect Populations of Sludge-Drying Beds, W72-01863	5D	PUMPING TESTS	
PROBABILITY		Viability of Long-Stored Airborne Bacterial Aerosols, W72-01882	5D	An Extended Theory of Delayed Yield from Storage Applied to Pumping Tests in Unconfined Anisotropic Aquifers, W72-02011	4B
Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States, W72-02210	2B	PUBLIC RIGHTS		QUABBIN RESERVOIR (MASS)	
Uncertainties in Digital-Computer Modeling of Groundwater Basins, W72-02215	2F	The Rights of the Public Versus the Rights of Riparian Owners to the Use of the Shore Between the Water's Edge and the High Water Mark on Lake Murray, W72-02150	6E	Hydrologic Factors in the Determination of Watershed Yields, W72-01700	2A
Conditional Streamflow Probability Distributions, W72-02223	6A	PUBLIC UTILITIES		QUASI-BIENNIAL CYCLES	
PROCESS CONTROL		Standard Utilities Location. W72-01821	8A	The Genesis of Sudden Stratospheric Warnings and the Quasi-Biennial Cycles,	
A Rational Evaluation of Instrumentation and Control Systems,		PUBLIC UTILITY DISTRICTS			
		Public Utilities-Water Authorities. W72-02145	6E		
		PUBLICATIONS			
		Hydrologic Computational Methods for Marine Hydraulic Engineering Construction (Metody morskikh gidrologicheskikh raschetov dlya tsely gidrotehnicheskogo stroitel'stva),			

SUBJECT INDEX

RESOURCE ALLOCATION

W72-02023	2B	W72-02220	2G	W72-01715	2C																																																																																																																																																																																																														
RADAR																																																																																																																																																																																																																			
Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements, W72-02014																																																																																																																																																																																																																			
	7B	RAINFALL SIMULATORS																																																																																																																																																																																																																	
The Use of a Realistic Rainfall Simulator to Determine Relative Infiltration Rates of Contributing Watersheds to the Lower Gila Below Painted Rock Dam, W72-02220																																																																																																																																																																																																																			
	2G																																																																																																																																																																																																																		
RADIOACTIVE WASTE DISPOSAL																																																																																																																																																																																																																			
Radioactive Wastes-Their Treatment and Disposal, W72-01871																																																																																																																																																																																																																			
	5D	REAERATION																																																																																																																																																																																																																	
Effect of Sunlight and Green Organisms on Re-aeration of Streams, W72-01794																																																																																																																																																																																																																			
	5C																																																																																																																																																																																																																		
RADIOACTIVE WASTES																																																																																																																																																																																																																			
Plutonium-239 in and Over the Atlantic Ocean, W72-02083																																																																																																																																																																																																																			
	5B	RECHARGE BASINS																																																																																																																																																																																																																	
Renovating Sewage Effluent by Ground-Water Recharge, W72-02226																																																																																																																																																																																																																			
	5D																																																																																																																																																																																																																		
RADIOCARBON DATING																																																																																																																																																																																																																			
Tree-Ring Dating of Colorado River Driftwood in the Grand Canyon, W72-02234																																																																																																																																																																																																																			
	7B	RECHARGE WELLS																																																																																																																																																																																																																	
Management of Artificial Recharge Wells for Groundwater Quality Control, W72-02228																																																																																																																																																																																																																			
	5G																																																																																																																																																																																																																		
RADIOISOTOPES																																																																																																																																																																																																																			
Bioaccumulation of Radioisotopes Through Aquatic Food Chains, W72-01792																																																																																																																																																																																																																			
	5B	RECLAIMED WATER																																																																																																																																																																																																																	
Reclaimed Waste Water for Groundwater Recharge, W72-02006																																																																																																																																																																																																																			
	5D																																																																																																																																																																																																																		
RAIN GAGES																																																																																																																																																																																																																			
Some Regional Differences in Runoff-Producing Thunderstorm Rainfall in the Southwest, W72-02214																																																																																																																																																																																																																			
	2B	Feasibility of Recharging Treated Sewage Effluent into a Deep Sandstone Aquifer, W72-02077																																																																																																																																																																																																																	
	5D																																																																																																																																																																																																																		
RAINFALL																																																																																																																																																																																																																			
Outline of a Bayesian Approach to the EML Multiple Cloud Seeding Experiments, W72-02058																																																																																																																																																																																																																			
	3B	Agricultural Utilization of Sewage Effluent and Sludge, an Annotated Bibliography, W72-02104																																																																																																																																																																																																																	
	5G																																																																																																																																																																																																																		
RECORDING RAIN GAGES																																																																																																																																																																																																																			
Some Regional Differences in Runoff-Producing Thunderstorm Rainfall in the Southwest, W72-02214																																																																																																																																																																																																																			
	2B																																																																																																																																																																																																																		
RECREATION																																																																																																																																																																																																																			
Water Quality Requirements for Recreational Uses, W72-01807																																																																																																																																																																																																																			
	5G																																																																																																																																																																																																																		
RECREATION DEMAND																																																																																																																																																																																																																			
A Methodology Study to Develop Evaluation Criteria for Wild and Scenic Rivers: Landowner Perception of Recreational Associated Conflicts in the Salmon-Little Salmon River Corridor of Idaho, W72-01746																																																																																																																																																																																																																			
	6B																																																																																																																																																																																																																		
RAINFALL DISPOSITION																																																																																																																																																																																																																			
Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere, W72-01741																																																																																																																																																																																																																			
	2B	Determining the Demand and Economic Value for the Water-Based Outdoor Recreation Resources at Lake MacBride State Park in the Summer of 1970, W72-01980																																																																																																																																																																																																																	
	6D																																																																																																																																																																																																																		
RAINFALL INTENSITY																																																																																																																																																																																																																			
A Method of Monitoring Mudflow Movements, W72-01722																																																																																																																																																																																																																			
	2J	Outdoor Recreation in New York State: Projections of Demand, Economic Value, and Pricing Effects for the Period 1970-1985, W72-02134																																																																																																																																																																																																																	
	6B																																																																																																																																																																																																																		
RAINFALL-RUNOFF RELATIONSHIPS																																																																																																																																																																																																																			
A Critical Review of Currently Available Hydrologic Models for Analysis of Urban Stormwater Runoff, W72-01978																																																																																																																																																																																																																			
	2A	REFORMATION																																																																																																																																																																																																																	
Removal of Orthophosphates From Aqueous Solutions with Activated Alumina, W72-01847																																																																																																																																																																																																																			
	5D																																																																																																																																																																																																																		
REGENERATION OF MEMBRANES																																																																																																																																																																																																																			
In-Situ Regenerable Membranes for Reverse Osmosis, W72-01837																																																																																																																																																																																																																			
	3A																																																																																																																																																																																																																		
REGIMEN																																																																																																																																																																																																																			
The Possible Future Behaviour of Berendon Glacier, Canada - A Further Study, W72-01709																																																																																																																																																																																																																			
	2C	RESOURCE ALLOCATION						Corrective Terms in the Glaciological Balance,												Inventory and Problem Delineation, Phase I Report, Regional Water Supply and Wastewater Disposal Study, W72-01830							6D	REGIONAL PLANNING						Water Quality Management Planning in South Carolina: A Planning Manual, W72-01825							6D	REGRESSION ANALYSIS						Outdoor Recreation in New York State: Projections of Demand, Economic Value, and Pricing Effects for the Period 1970-1985, W72-02134							6B	REGULATION						Pollution Control Act, W72-02139							6E	REMOTE SENSING						Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements, W72-02014							7B	Detection of Thawing Snow and Ice Packs Through the Combined use of Visible and Near-Infrared Measurements from Earth Satellites, W72-02016							7B	A System Analysis of Applications of Earth Orbital Space Technology to Selected Cases in Water Management and Agriculture-Volume 1, Technical Summary, W72-02029							7B	REPUBLIC OF SOUTH AFRICA						South Africa and Its Water Problem (L'Afrique du Sud et le Probleme de L'eau), W72-02209							4A	RESEARCH AND DEVELOPMENT						Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769							8E	RESERVOIR CONSTRUCTION						Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestestvennye usloviya uvlazhneniya territorii Obskogo basseyna i perspektiv gidromelioratsii), W72-02063							4A	RESERVOIR EVAPORATION						Evaluation of Effect of Impoundment on Water Quality in Cheney Reservoir, W72-01773							5F	South Africa and Its Water Problem (L'Afrique du Sud et le Probleme de L'eau), W72-02209							4A	RESERVOIR OPERATION						Digital Simulation of an Existing Water Resources System, W72-02132							6A	RESERVOIRS						Hydrologic Factors in the Determination of Watershed Yields, W72-01700							2A	Multireservoir Analysis Techniques in Water Quantity Studies, W72-02057							4A	RESOURCE ALLOCATION						Validation of Political Simulation Models - Water Resource Projects,					
RESOURCE ALLOCATION																																																																																																																																																																																																																			
Corrective Terms in the Glaciological Balance,																																																																																																																																																																																																																			
Inventory and Problem Delineation, Phase I Report, Regional Water Supply and Wastewater Disposal Study, W72-01830																																																																																																																																																																																																																			
	6D																																																																																																																																																																																																																		
REGIONAL PLANNING																																																																																																																																																																																																																			
Water Quality Management Planning in South Carolina: A Planning Manual, W72-01825																																																																																																																																																																																																																			
	6D																																																																																																																																																																																																																		
REGRESSION ANALYSIS																																																																																																																																																																																																																			
Outdoor Recreation in New York State: Projections of Demand, Economic Value, and Pricing Effects for the Period 1970-1985, W72-02134																																																																																																																																																																																																																			
	6B																																																																																																																																																																																																																		
REGULATION																																																																																																																																																																																																																			
Pollution Control Act, W72-02139																																																																																																																																																																																																																			
	6E																																																																																																																																																																																																																		
REMOTE SENSING																																																																																																																																																																																																																			
Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements, W72-02014																																																																																																																																																																																																																			
	7B																																																																																																																																																																																																																		
Detection of Thawing Snow and Ice Packs Through the Combined use of Visible and Near-Infrared Measurements from Earth Satellites, W72-02016																																																																																																																																																																																																																			
	7B																																																																																																																																																																																																																		
A System Analysis of Applications of Earth Orbital Space Technology to Selected Cases in Water Management and Agriculture-Volume 1, Technical Summary, W72-02029																																																																																																																																																																																																																			
	7B																																																																																																																																																																																																																		
REPUBLIC OF SOUTH AFRICA																																																																																																																																																																																																																			
South Africa and Its Water Problem (L'Afrique du Sud et le Probleme de L'eau), W72-02209																																																																																																																																																																																																																			
	4A																																																																																																																																																																																																																		
RESEARCH AND DEVELOPMENT																																																																																																																																																																																																																			
Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769																																																																																																																																																																																																																			
	8E																																																																																																																																																																																																																		
RESERVOIR CONSTRUCTION																																																																																																																																																																																																																			
Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestestvennye usloviya uvlazhneniya territorii Obskogo basseyna i perspektiv gidromelioratsii), W72-02063																																																																																																																																																																																																																			
	4A																																																																																																																																																																																																																		
RESERVOIR EVAPORATION																																																																																																																																																																																																																			
Evaluation of Effect of Impoundment on Water Quality in Cheney Reservoir, W72-01773																																																																																																																																																																																																																			
	5F																																																																																																																																																																																																																		
South Africa and Its Water Problem (L'Afrique du Sud et le Probleme de L'eau), W72-02209																																																																																																																																																																																																																			
	4A																																																																																																																																																																																																																		
RESERVOIR OPERATION																																																																																																																																																																																																																			
Digital Simulation of an Existing Water Resources System, W72-02132																																																																																																																																																																																																																			
	6A																																																																																																																																																																																																																		
RESERVOIRS																																																																																																																																																																																																																			
Hydrologic Factors in the Determination of Watershed Yields, W72-01700																																																																																																																																																																																																																			
	2A																																																																																																																																																																																																																		
Multireservoir Analysis Techniques in Water Quantity Studies, W72-02057																																																																																																																																																																																																																			
	4A																																																																																																																																																																																																																		
RESOURCE ALLOCATION																																																																																																																																																																																																																			
Validation of Political Simulation Models - Water Resource Projects,																																																																																																																																																																																																																			

SUBJECT INDEX

RETENTION PONDS

W72-02129

RETENTION PONDS

Water Geochemistry of Mining and Milling Retention in the 'New Lead Belt' of Southeast Missouri,
W72-01692

RETURN FLOW

Characteristics and Pollution Problems of Irrigation Return Flow.
W72-01984

REVERSE OSMOSIS

Reverse Osmosis Pilot Plant for Desalination of Sea Water,
W72-01831

Improved Membranes for Reverse Osmosis,
W72-01833

In-Situ Regenerable Membranes for Reverse Osmosis,
W72-01837

The Design, Fabrication and Testing of a 1000 Gallon Per Day Tubular Reverse Osmosis Pilot Plant,
W72-02045

Membranes for Desalination by Reverse Osmosis,
W72-02046

Large Reverse Osmosis System Technology and Module Development,
W72-02047

Development of New and Improved Cellulose Ester Reverse Osmosis Membranes,
W72-02049

Final Report on Control of Concentration Polarization in Reverse Osmosis Desalination of Water,
W72-02107

New and Improved Cellulose Ester Membranes,
W72-02111

REVERSIBLE TURBINES

Pumped Storage: State-of-the-Art.
W72-01771

REVIEWS

Pumped Storage: State-of-the-Art.
W72-01771

Oxygen Sag and Stream Self-Purification,
W72-01785

Geochemical Interpretations of Groundwater Flow Systems,
W72-02007

Sediment Transportation Mechanics: Fundamentals of Sediment Transportation.
W72-02059

1970 Literature Review, Administration: Economics,
W72-02140

RHEOLOGY

On the Temperature Profile and the Age Profile in the Central Part of Cold Ice Sheets,
W72-01705

Creep of Ice Under Low Stress,

6A W72-02091

RIDDANCE (LEGAL ASPECTS)

What Constitutes Natural Drainway or Watercourse for Flow of Surface Water.
W72-02156

RIGHT-OF-WAY

Standard Utilities Location.
W72-01821

RIPARIAN LAND

The Rights of the Public Versus the Rights of Riparian Owners to the Use of the Shore Between the Water's Edge and the High Water Mark on Lake Murray,
W72-02150

RIPARIAN WATERS

Limitation on Diversion From the Watershed: Riparian Roadblock to Beneficial Use,
W72-02149

RIVER BASIN DEVELOPMENT

A Bill to Amend the Federal Water Pollution Control Act to Provide Financial Assistance for River Basin Programs.
W72-02141

RIVER BASINS

The Chalus Valley and its Terraces: Studies in the History and Regionalization of the Central Elbur (North Iran) (Das Chalus-Tal und Seine Terrassen, Studien Zur Landschaftsgliederung und Landschaftsgeschichte des Mit tieren Elburs, (Nordiran),
W72-02207

RIVER SURVEYS

Aquatic Organisms as an Aid in Solving Waste Disposal Problems,
W72-01801

RIVERS

The Plankton of the Sangamon River in the Summer of 1929,
W72-01795

Natural Relationships of Indicator and Pathogenic Bacteria in Stream Waters,
W72-01996

Two Investigations of River Ice: Part I and Part 2,
W72-02056

ROAD CONSTRUCTION

Enhancement of Ecologic and Aesthetic Values of Water Associated with Interstate Highways,
W72-01698

ROADS

Rockfill,
W72-01765

ROCK FILLS

Rockfill,
W72-01765

ROCK FOUNDATIONS

Deformation Moduli Determined by Joint-Shear Index and Shear Catalog,
W72-01769

ROCKFILL DAMS

Rockfill,

2C W72-01765

ROCKFORD (ILL)

Low Cost Storm Drainage With Paved Channels,
W72-01880

RUNOFF

Water-Borne Typhoid Epidemic at Keene, New Hampshire,
W72-01810

RUNOFF

Surface-Water Resources of the Ob River and Ob-Irtyshev Interfluve (Resursy poverkhnostnykh vod r. Obi i Ob-Irtyshevskogo mezhdurech'ya),
W72-02065

Formation of Spring Runoff in the Vasyugan'ye (O formirovaniyu vesennego stoka v usloviyakh Vasyugan'ya),
W72-02068

Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniyu vesennego stoka i yeye realizatsiya dlya prognoza gidrografa),
W72-02096

Augmenting Annual Runoff Records Using Tree-Ring Data,
W72-02213

Progress in Developing Forest Management Guidelines for Increasing Snowpack Water Yields,
W72-02230

RUNOFF COEFFICIENT

A Critical Review of Currently Available Hydrologic Models for Analysis of Urban Stormwater Runoff,
W72-01978

RUNOFF EFFICIENCY

Progress in Developing Forest Management Guidelines for Increasing Snowpack Water Yields,
W72-02230

RUNOFF FORECASTING

Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniyu vesennego stoka i yeye realizatsiya dlya prognoza gidrografa),
W72-02096

SALINE LAKES

Saline Lake Basins of the Southern High Plains,
W72-01752

SALINE RIVER (MICH)

Natural Relationships of Indicator and Pathogenic Bacteria in Stream Waters,
W72-01996

SALINE SOILS

Long Term Movement of Water and Soil Salinity in the Weathering Zone of Arid Zone Sediments,
W72-01753

SALINE WATER

Change of Chloride Content of Water in Response to Pumping in the Artesian Aquifer in the Roswell-East Grant Plains Area, Chaves County, New Mexico,
W72-01751

Model Studies of Outfall Systems for Desalination Plants (Part I - Flume Study),
W72-01751

SUBJECT INDEX

SEDIMENTS			
<p>W72-01838 5E</p> <p>SALINE WATER-FRESHWATER INTERFACES Discontinuities in Stratified Flows, W72-01723 2E</p> <p>SALINE WATER SYSTEMS Saline Lake Basins of the Southern High Plains, W72-01752 2F</p> <p>A Survey of Saline Ground Water as a Mineral Resource, W72-01754 2K</p> <p>Saline Waters: Genesis and Relationship to Sediments and Host Rocks, W72-01755 2K</p> <p>SALINITY Permeability, Brine Content and Temperature of Temperate Ice, W72-01706 2C</p> <p>Characteristics and Pollution Problems of Irrigation Return Flow. W72-01984 5B</p> <p>Salinity of Surface Water in the Lower Colorado River - Salton Sea Area, W72-02074 2K</p> <p>Effect of Growth Parameters on Substructure Spacing in NaCl Ice Crystals, W72-02092 2C</p> <p>SALMONIDS Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02159 5B</p> <p>Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02160 5B</p> <p>SALT BALANCE Present-day and Long-term Water and Salt Balance of Southern Seas of the USSR (Azov, Caspian and Aral) and Possible Changes in Their Hydrologic and Hydrochemical Regimes (Sovremenny i perspektivny vodny i solevov balansy i vozmozhnye izmeneniya gidrologicheskogo i gidrokhimicheskogo rezhimov yuzhnykh morey SSSR (Azovskogo, Kaspiskogo i Aralskogo)), W72-02099 2H</p> <p>SALT RIVER VALLEY Renovating Sewage Effluent by Ground-Water Recharge, W72-02226 5D</p> <p>SAMPLER Design and Construction of a Shallow Water Sediment Core Sampler, W72-01738 5A</p> <p>SAMPLING A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use, W72-01735 5C</p> <p>Design and Construction of a Shallow Water Sediment Core Sampler, W72-01738 5A</p> <p>Value of the Bottom Sampler in Demonstrating the Effects of Pollution on Fish-Food Organisms and Fish in the Shenandoah River,</p>	<p>W72-01800 5C</p> <p>SAND BARS Grand Isle: A Barrier Island in the Gulf of Mexico, W72-01718 2J</p> <p>Heavy Minerals of Northern Sand Key, Pinellas County, Florida, W72-01732 2J</p> <p>SAND SPITS Grand Isle: A Barrier Island in the Gulf of Mexico, W72-01718 2J</p> <p>SAND WAVES Height of Sand Dunes in Open Channel Flows, W72-02021 2J</p> <p>SANITARY ENGINEERING Suggested Classification of Algae and Protozoa in Sanitary Science, W72-01798 5C</p> <p>Aquatic Biology and the Water Works Engineer, W72-01813 5C</p> <p>SAPROBIA Ecology of Plant Saprobia, W72-01793 5C</p> <p>Ecology of Animal Saprobia, W72-01799 5C</p> <p>SATELLITES (ARTIFICIAL) Detection of Thawing Snow and Ice Packs Through the Combined use of Visible and Near-Infrared Measurements from Earth Satellites, W72-02016 7B</p> <p>SATURATION Aerator Performance in Natural Streams, W72-01842 5G</p> <p>SEA ICE Basement Ice, Ward Hunt Ice Shelf, Ellesmere Island, Canada, W72-01710 2C</p> <p>Albedo of Melting Sea Ice in the Southern Beaufort Sea, W72-01711 2C</p> <p>Winter Commerce on the Baltic: Some Implications on Opening the Great Lakes, W72-02143 6B</p> <p>SEA WATER Some Exact Solutions to the Equations Describing an Ideal-Fluid Thermocline, W72-02032 2G</p> <p>On Potential Density in the Deep South Atlantic Ocean, W72-02037 2E</p> <p>Development of New and Improved Cellulose Ester Reverse Osmosis Membranes, W72-02049 3A</p> <p>Plutonium-239 in and Over the Atlantic Ocean, W72-02083 5B</p> <p>Cesium-137 in the North Atlantic Measured by Selective Absorption in Situ, W72-02084 5B</p> <p>SEALANTS Survey of Applications of Epoxy Resins for Civil Works Projects,</p>	<p>W72-02120 8G</p> <p>SECONDARY ECONOMIC EFFECTS Secondary Economic Effects of Irrigation on the Colorado High Plains, W72-02136 6B</p> <p>SEDIMENT CONTROL Control of Sediments Resulting from Highway Construction and Land Development, W72-02106 2J</p> <p>SEDIMENT DISTRIBUTION Optical Fourier Transform Technique for Measuring Sediment Concentration, W72-02158 2J</p> <p>SEDIMENT TRANSPORT Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation, W72-01727 2J</p> <p>Height of Sand Dunes in Open Channel Flows, W72-02021 2J</p> <p>Sediment Transportation Mechanics: Fundamentals of Sediment Transportation, W72-02059 2J</p> <p>A Class of Probability Models for Littoral Drift, W72-02121 6A</p> <p>SEDIMENT YIELD Control of Sediments Resulting from Highway Construction and Land Development, W72-02106 2J</p> <p>Blue-Green Algal Effects on Some Hydrologic Processes at the Soil Surface, W72-02218 2G</p> <p>SEDIMENTARY ROCKS Iodine and Algae in Sedimentary Rocks Associated with Iodine-Rich Brines, W72-02073 2K</p> <p>SEDIMENTATION Heavy Minerals of Northern Sand Key, Pinellas County, Florida, W72-01732 2J</p> <p>Aleutian Plain Sediments and Lithospheric Plate Motions, W72-02043 2J</p> <p>Sediment Transportation Mechanics: Fundamentals of Sediment Transportation, W72-02059 2J</p> <p>Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notamment Des Fabriques de Pate a Papier et d'Huile Vegetale Hydrogenee), W72-02208 5B</p> <p>SEDIMENTS Design and Construction of a Shallow Water Sediment Core Sampler, W72-01738 5A</p> <p>The Diversity of Pigments in Lake Sediments and Its Ecological Significance,</p>	

SUBJECT INDEX

SEDIMENTS

W72-01784	5C	W72-01757	3F	W72-01817	5D
Organic-Inorganic Associations: Their Formation and Involvement in Nutrient Mobilization from the Sediments of Lakes, W72-02053	2H	Effective Drought Control for Successful Dry-land Agriculture, W72-01759	3F	Biological Factors in Treatment of Raw Sewage in Artificial Ponds, W72-01818	5D
Oxidation-Reduction Determinations at The Mud-Water Interface, W72-02054	2H	SEPARABLE COSTS		Trickling Filter Ecology, W72-01819	5D
Characterization of Inorganic Phosphate in Noncalcareous Lake Sediments, W72-02113	2H	Economics and Politics in Water Pollution Control, W72-02135	5G	Selection and Adaptation of Microorganisms in Waste Treatment, W72-01820	5D
Optical Fourier Transform Technique for Measuring Sediment Concentration, W72-02158	2J	SEPARATION TECHNIQUES		The Disposal of Agricultural Waste, W72-02142	5E
SEED DORMACY		Removal of Orthophosphates From Aqueous Solutions with Activated Alumina, W72-01847	5D	SEWERS	
Drought Influence on Germination and Seedling Emergence, W72-01739	3F	Coagulation of Activated Carbon Suspensions, W72-01862	5E	Standard Utilities Location, W72-01821	8A
SEED STORAGE		Colloid Flotation and Adsorbing Colloid Flotation, W72-02105	5D	Island City Solves Tough Sewerage Problem, W72-01855	5D
Drying Rates of Birdsfoot Trefoil Seed, W72-02089	3F	SERIES CAPACITORS		Jacking a Sewer Under an Interstate Highway, W72-01856	5D
SEED TREATMENT		A Study of Reinsertion Transient Voltages for Series Capacitors on USBR Glen Canyon - Flagstaff 345 KV Lines, W72-01775	8C	Sewerage Practice in the Gulf Coast Area, W72-01861	5D
Drying Rates of Birdsfoot Trefoil Seed, W72-02089	3F	SETTLEMENT (STRUCTURAL)		SHALLOW WELLS	
SEEDLINGS		Rockfill, W72-01765	8D	Recharging the Ogallala Formation Using Shallow Holes, W72-02227	4B
Drought Influence on Germination and Seedling Emergence, W72-01739	3F	SETTLING BASINS		SHEAR CATALOG	
Can We Breed for Drought Resistance, W72-01757	3F	Shapes of Grit Chambers to Achieve Certain Velocity-Head Relations with given Shapes of Outlet Weirs, W72-01729	8B	Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769	8E
SEEDS		SETTLING BASINS		SHEAR STRESS	
Drought Influence on Germination and Seedling Emergence, W72-01739	3F	Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notamment Des Fabricues de Pate a Papier et d'Huile Vegetale Hydrogene), W72-02208	5B	Shear Stress at the Base of a Rigidly Cirque Glacier, W72-01707	2C
Sugar Beets in Arizona, W72-01742	3F	SEWAGE		SHRUBS	
Drying Rates of Birdsfoot Trefoil Seed, W72-02089	3F	Sewage, Algae and Fish, W72-01788	5C	Patterns in Desert Perennials, W72-01760	21
SEICHES		The Effects of Sewage Pollution on the Fish Population of a Midwestern Stream, W72-01805	5C	SILTING	
Seiche Motions for a Basin of Rectangular Plan and of Nonuniform Depth, W72-02031	2E	Relationship Between Escherichia Coli, Type I and Enterococci in Water, W72-01854	5B	Effect of Siltation, Resulting from Improper Logging, on the Bottom Fauna of a Small Trout Stream in the Southern Appalachians, W72-01802	5C
Observations on Short-Period Internal Waves in Massachusetts Bay, W72-02035	2L	SEWAGE DISPOSAL		SILVER IODIDE	
SEISMIC STUDIES		The Disposal of Agricultural Waste, W72-02142	5E	Complexes of Silver Iodide and Secondary Amines, W72-02072	3B
Refraction Seismic Investigation at Zemu Glacier, Sikkim, W72-02000	2C	SEWAGE EFFLUENT		SIMULATED RAINFALL	
SELF-PURIFICATION		Potential Plant Pathogenic Fungi in Sewage and Polluted Water, W72-01809	5C	Blue-Green Algal Effects on Some Hydrologic Processes at the Soil Surface, W72-02218	2G
Oxygen Sag and Stream Self-Purification, W72-01785	5C	SEWAGE EFFLUENTS		MULTI-SITE STREAMFLOW SIMULATION	
Biological Aspects of Stream Pollution, W72-01789	5C	Renovating Sewage Effluent by Ground-Water Recharge, W72-02226	5D	Multi-Site Streamflow Simulation of Truckee River, Nevada, W72-01778	2E
Ecology of Plant Saprobia, W72-01793	5C	SEWAGE TREATMENT		VALIDATION OF POLITICAL SIMULATION MODELS	
Ecology of Animal Saprobia, W72-01799	5C	Biology of Water Pollution: A Collection of Selected Papers on Stream Pollution, Waste Water, and Water Treatment, W72-01786	5C	Validation of Political Simulation Models - Water Resource Projects, W72-02129	6A
SEMIARID CLIMATES		Protozoa and Activated Sludge,		IRRIGATION PLANNING 2: CHOOSING OPTIMAL ACRES WITHIN A SEASON	
Statistical Inference on Streamflow Processes with Markovian Characteristics, W72-01704	2E			The Simulation and Optimization of a Single Effect Multi-Stage Flash Desalination Plant, W72-02131	6A
Can We Breed for Drought Resistance,				DIGITAL SIMULATION OF AN EXISTING WATER RESOURCES SYSTEM	

SUBJECT INDEX

				SOLVATION
W72-02132	6A	W72-01752	2F	W72-02222
SKEWNESS ERRORS				2G
Finite-Difference Convection Errors, W72-01858	7C	SOIL ALGAE Blue-Green Algal Effects on Some Hydrologic Processes at the Soil Surface, W72-02218	2G	SOIL PROPERTIES Dynamic Simulation of Vertical Infiltration into Unsaturated Soils, W72-01782
SLUDGE				2G
Operating Experiences with Vacuum Filtration at St. Helens: A Solution to the Problem, W72-01849	5D	SOIL CHEMICAL PROPERTIES Effects of Fire on Water Infiltration Rates in a Ponderosa Pine Stand, W72-02219	2G	SOIL SURFACES Blue-Green Algal Effects on Some Hydrologic Processes at the Soil Surface, W72-02218
Insect Populations of Sludge-Drying Beds, W72-01863	5D	SOIL CHEMISTRY Effects of Recent and Past Phosphate Fertilization on the Amount of Phosphorus Percolating Through Soil Profiles into Subsurface Waters, W72-01691	2G	SOIL TYPES Blue-Green Algal Effects on Some Hydrologic Processes at the Soil Surface, W72-02218
SLUDGE DISPOSAL				2G
The De-Watering of Digested Sludge Using Synthetic Filtering Agents, W72-01846	5E	SOIL CONSERVATION Use and Abuse of Southwestern Rivers. The Pueblo Dweller, W72-02236	3F	SOIL WATER Investigations of Moisture Exchange in the Zone of Aeration in Irrigated Land (Issledovaniya vlagooobmena v zone aeratsii na oroshayemykh zemlyakh), W72-02070
The Barged Ocean Disposal of Wastes: A Review of Current Practice and Methods of Evaluation, W72-01987	5C	SOIL DRYING Seasonal Effects on Soil Drying After Irrigation, W72-02217	2D	4A
AGRICULTURE				SOIL ENVIRONMENT Nitrogen Balance For a 23 Square Mile Minnesota Watershed, W72-02216
Agricultural Utilization of Sewage Effluent and Sludge, an Annotated Bibliography, W72-02104	5G	2K	SOIL WATER MOVEMENT Some Geographic Implications of Water-Repellent Soils, W72-01745	
SNAKE RIVER				2G
On the Economic Impact of Large Diversions of Snake River Waters, W72-02124	6D	Time in Transit of Water Moving Vertically for Ground Water Recharge, W72-01750	2G	
Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02159	5B	Long Term Movement of Water and Soil Salinity in the Weathering Zone of Arid Zone Sediments, W72-01753	2G	
Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02160	5B	SOIL ENVIRONMENT Bedrock Weathering and Residual Soil Formation in Central Virginia, W72-01716	2J	
SNOW				Dynamic Simulation of Vertical Infiltration into Unsaturated Soils, W72-01782
Snow in Ohio, W72-02027	2C	Drought Influence on Germination and Seedling Emergence, W72-01739	3F	2G
SNOWFALL				Seasonal Effects on Soil Drying After Irrigation, W72-02217
Snow in Ohio, W72-02027	2C	W72-01744	2G	2D
SNOWFALL RECORDS (OHIO)				SOIL-WATER-PLANT RELATIONSHIPS Psychrometric Determination of Water Potential of Desert Plants, W72-01761
Snow in Ohio, W72-02027	2C	A Critical Review of Currently Available Hydrologic Models for Analysis of Urban Stormwater Runoff, W72-01798	2A	2I
SNOWMELT				Irrigation Planning 2: Choosing Optimal Acres Within a Season, W72-02130
Hydrologic Characterization of Forested Watersheds in Arizona, W72-01702	2C	Investigations of Moisture Exchange in the Zone of Aeration in Irrigated Land (Issledovaniya vlagooobmena v zone aeratsii na oroshayemykh zemlyakh), W72-02070	4A	6A
Detection of Thawing Snow and Ice Packs Through the Combined use of Visible and Near-Infrared Measurements from Earth Satellites, W72-02016	7B	Field Measurements of Soil-Water Content and Soil-Water Pressure, W72-02222	2G	
PROGRESS IN FOREST MANAGEMENT				SOIL MOISTURE TENSION Field Measurements of Soil-Water Content and Soil-Water Pressure, W72-02222
Progress in Developing Forest Management Guidelines for Increasing Snowpack Water Yields, W72-02230	4A	2G	SOIL MOISTURE TENSION Field Measurements of Soil-Water Content and Soil-Water Pressure, W72-02222	
SNOWPACKS				SOIL PHYSICAL PROPERTIES Some Geographic Implications of Water-Repellent Soils, W72-01745
Detection of Thawing Snow and Ice Packs Through the Combined use of Visible and Near-Infrared Measurements from Earth Satellites, W72-02016	7B	2G	SOIL PHYSICAL PROPERTIES Some Geographic Implications of Water-Repellent Soils, W72-01745	
SOCIAL VALUES				SOIL PIPING Recharging the Ogallala Formation Using Shallow Holes, W72-02227
Environment Crises, W72-01694	6B	4B	SOIL PIPING Recharging the Ogallala Formation Using Shallow Holes, W72-02227	
SODIUM SULFATE				SOIL PROFILES Field Measurements of Soil-Water Content and Soil-Water Pressure, W72-02222
Saline Lake Basins of the Southern High Plains,				SOIL PROFILES Field Measurements of Soil-Water Content and Soil-Water Pressure, W72-02222
SOLID WASTES				SOLID WASTES Radioactive Wastes-Their Treatment and Disposal, W72-01871
SOLIDS CONTENT				5D
Operating Experiences with Vacuum Filtration at St. Helens: A Solution to the Problem, W72-01849				SOIL PROFILES Field Measurements of Soil-Water Content and Soil-Water Pressure, W72-02222
SOLUTES				SOLID WASTES Radioactive Wastes-Their Treatment and Disposal, W72-01871
SOLVATION				5D
Solute Properties of Water--Part II, W72-02110				SOLUTES Solute Properties of Water--Part II, W72-02110
SOLVATION				1A
SOLVATION				SOLVATION Solute Properties of Water--Part II, W72-02110

SUBJECT INDEX

SORPTION

W72-02110	1A	W72-01728	8B	W72-02020	8B
SORPTION					
Effects of Recent and Past Phosphate Fertilization on the Amount of Phosphorus Percolating Through Soil Profiles into Subsurface Waters, W72-01691 2G					
SOUNDING					
Refraction Seismic Investigation at Zemu Glacier, Sikkim, W72-02000 2C					
SOUTH CAROLINA					
Pollution Control Act, W72-02139 6E					
Limitation on Diversion From the Watershed: Riparian Roadblock to Beneficial Use, W72-02149 6E					
The Rights of the Public Versus the Rights of Riparian Owners to the Use of the Shore Between the Water's Edge and the High Water Mark on Lake Murray, W72-02150 6E					
SOUTHWEST U. S.					
Terraces and Pediment-Terraces in the Southwest: An Interpretation, W72-01719 2J					
SOUTHWEST U. S.					
Some Regional Differences in Runoff-Producing Thunderstorm Rainfall in the Southwest, W72-02214 2B					
SOYBEANS					
Energy Balance and Spectral Properties of a ReflectORIZED Soybean Canopy, W72-01747 3F					
SPAR BUOYS					
A Stable Spar-Buoy Platform for Mounting Instrumentation, W72-02039 7B					
SPECTROSCOPY					
Energy Balance and Spectral Properties of a ReflectORIZED Soybean Canopy, W72-01747 3F					
SPEEDWAY (IND)					
Jacking a Sewer Under an Interstate Highway, W72-01856 5D					
SPILLWAYS					
Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02159 5B					
Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02160 5B					
SPIRAL WOUND MODULE					
Large Reverse Osmosis System Technology and Module Development, W72-02047 3A					
SPRINGS					
Some Aspects of the Geochemistry of F, Fe and Mn in Coastal Waters and in Fresh-Water Springs on the Southeast Coast of Hawaii, W72-01998 2K					
STAGE-DISCHARGE RELATIONS					
Determination of the Loop Discharge Rating Curve for Flood Wave Propagation, W72-01724 2E					
Linear Proportional Weirs with Trapezoidal Bottoms,					
STANDARD UTILITY LOCATIONS					
Standard Utilities Location, W72-01821 8A					
STANDARDS					
Water Quality Requirements for Recreational Uses, W72-01807 5G					
Oxygen Requirements of Some Marine and Anadromous Fishes, with Particular Reference to Problems of Measurement, W72-01875 5C					
A Critical Examination of Bathing Water Quality Standards, W72-01997 5B					
Comparison of Plant Water Quality to Proposed Water Quality Standard, W72-02082 5F					
National Water Quality Standards Act of 1971, W72-02154 5G					
STANDING WATERS					
Enhancement of Ecologic and Aesthetic Values of Water Associated with Interstate Highways, W72-01698 4C					
STATE COLLEGE (PA)					
Ground-Water Pollution Potential of a Landfill above the Water Table, W72-02081 5B					
STATE JURISDICTION					
Bosarge V. State (Outer Limits of Alabama's Territorial Jurisdiction), W72-02133 6E					
STATION EXPOSURE					
Influences of Exposure on Pan Evaporation in a Mountainous Area, W72-02119 2D					
STATISTICAL METHODS					
Analysis of Periodicity in Hydrological Sequences, W72-02012 2A					
A Statistical Theory of Water Level Fluctuations in Undrained Bodies of Water (O statisticheskoy teorii kolebaniy urovney vody v besstochnykh vodoyemakh), W72-02097 2H					
Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States, W72-02210 2B					
STATISTICAL MODELS					
Augmenting Annual Runoff Records Using Tree-Ring Data, W72-02213 2E					
Conditional Streamflow Probability Distributions, W72-02223 6A					
A Stochastic Analysis of Flows on Rillito Creek, W72-02224 2E					
STILLING BASINS					
Drag Forces on Baffle Blocks in Hydraulic Jumps, W72-02019 8B					
Hydraulic Jump Assisted by Cross-Jet,					
STOCHASTIC PROCESSES					
Spectral Density of a River Flow Time Series, W72-02010 2E					
Conditional Streamflow Probability Distributions, W72-02223 6A					
A Stochastic Analysis of Flows on Rillito Creek, W72-02224 2E					
Optimal Utilization of Playa Lake Water in Irrigation, W72-02231 3F					
STORAGE					
South Africa and Its Water Problem (L'Afrique du Sud et le Probleme de L'eau), W72-02209 4A					
STORM DRAINS					
Low Cost Storm Drainage With Paved Channels, W72-01880 4A					
STORM RUNOFF					
Effect of Urbanization on Storm Water Peak Flows, W72-01857 4C					
STORM STRUCTURE					
Some Regional Differences in Runoff-Producing Thunderstorm Rainfall in the Southwest, W72-02214 2B					
STRAIN					
Determination of the Three-Dimensional Velocity Field in a Glacier, W72-02147 2C					
STRAIN RATE					
Creep of Ice Under Low Stress, W72-02091 2C					
STRATIFICATION					
Dissolved Oxygen Variations in Stratified Lakes, W72-01864 5C					
Temperature and Conductivity Measurements Under Ice Island T-3, W72-02042 2K					
STRATIFIED FLOW					
Discontinuities in Stratified Flows, W72-01723 2E					
Transient Motions induced by Local Disturbances in a Linearly Density-Stratified Fluid, W72-01726 2E					
STRATOSPHERIC WARMINGS					
The Genesis of Sudden Stratospheric Warmings and the Quasi-Biennial Cycles, W72-02023 2B					
STREAM EROSION					
Channel Stability in the Estuary: Controls by Bedrock and Unconsolidated Post-Glacial Sediment, W72-01721 2L					
STREAM FLOW					
Model for Flow Augmentation Analysis-An Overview,					

SUBJECT INDEX

SYSTEMATICS

W72-01874	5G	W72-01804	5C	W72-02030	2C
STREAM GAGES					
Linear Proportional Weirs with Trapezoidal Bottoms, W72-01728					
	8B		8G		5B
STREAMFLOW					
Predicting Variations in Energy Flow Through a Semi-Controlled Lotic Ecosystem, W72-01701					
	2I				
Statistical Inference on Streamflow Processes with Markovian Characteristics, W72-01704					
	2E		5G		
Multi-Site Streamflow Simulation of Truckee River, Nevada, W72-01778					
	2E		5D		2K
Aerator Performance in Natural Streams, W72-01842					
	5G		5D		
Predicting Effects of Dead Zones on Stream Mixing, W72-01853					
	5B		2G		5B
Spectral Density of a River Flow Time Series, W72-02010					
	2E		2C		5D
Two Investigations of River Ice: Part I and Part 2, W72-02056					
	2C		3F		
Surface-Water Resources of the Ob River and Ob-Irtish Interfluve (Resursy poverkhnostnykh vod r. Ob i Ob'-Irtishskogo mezhdurech'ya), W72-02065					
	4A		3F		
Formation of Spring Runoff in the Vasyugan'-ye (O formirovaniye vesennego stoka v usloviyakh Vasyugan'-ya), W72-02068					
	4A		5D		
Economic Evaluation of Some Watershed Management Alternatives on Forest Land in West Virginia, W72-02146					
	4A		5D		
Conditional Streamflow Probability Distributions, W72-02223					
	6A		2H		
A Stochastic Analysis of Flows on Rillito Creek, W72-02224					
	2E		8F		
STREAMFLOW FORECASTING					
Analysis of Periodicity in Hydrological Sequences, W72-02012					
	2A		4B		
STREAMS					
Oxygen Sag and Stream Self-Purification, W72-01785					
	5C		6E		
Seawage, Algae and Fish, W72-01788					
	5C		2F		
Biological Aspects of Stream Pollution, W72-01789					
	5C		8G		
Some Important Biological Effects of Pollution Often Disregarded in Stream Surveys, W72-01790					
	5C		8G		
Stream Life and the Pollution Environment, W72-01803					
	5C				
Detection and Measurement of Stream Pollution,					

STRESS WAVES

Field Evaluation of Heavy-Walled Pressure Vessels Using Acoustic Emission Analysis,
W72-01776

STRUCTURAL GEOLOGY

Aleutian Plain Sediments and Lithospheric Plate Motions,
W72-02043

SUBROUTINES

Model for Flow Augmentation Analysis-An Overview,
W72-01874

SUBSTRATE REMOVAL

Mechanism and Kinetics of Substrate Utilization at High Biological Solids Concentrations,
W72-01843

SUBSURFACE FLOW

Time in Transit of Water Moving Vertically for Ground Water Recharge,
W72-01750

SUBSURFACE INVESTIGATIONS

A New Bore-Hole Inclinometer,
W72-02001

SUBWAYS

Effects of Temporary and Permanent Blankets on Tides and Currents in East River, Hydraulic Model Investigation,
W72-01827

SUGAR BEETS

Sugar Beets in Arizona,
W72-01742

SUGARCANE

Sugar Beets in Arizona,
W72-01742

SULFATE IONS

Effect of Sulfate and Other Ions in Coagulation with Aluminum,
W72-01869

SULFATES

Effect of Sulfate and Other Ions in Coagulation with Aluminum,
W72-01869

Observations of the Mud-Water Interface,
W72-02052

SULFURIC ACID

Sulfuric Acid Attack on Concrete Sewer Pipe,
W72-01848

SUMPS

Test of the Stroebel Spring - A Supplementary Study of the Fort Carson Expansion Project, Civil Action No. 8920, Tract No. 202, El Paso County, Colorado,
W72-02088

SURFACE DRAINAGE

What Constitutes Natural Drainway or Watercourse for Flow of Surface Water.
W72-02156

SURFACE-GROUNDWATER RELATIONSHIPS

Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals,
W72-01781

PERMAFROST-HYDROGEOLOGIC REGIMEN

Permafrost-Hydrogeologic Regimen in Two Ice-Free Valleys, Antarctica, from Electrical Depth Sounding,

SURFACE RUNOFF

Relationship Between Escherichia Coli, Type I and Enterococci in Water,
W72-01854

SURFACE WATERS

Microwave Radiometric Detection of Oil Slicks,
W72-02024

SURFACE-WATER RESOURCES

Surface-Water Resources of the Ob River and Ob-Irtish Interfluve (Resursy poverkhnostnykh vod r. Ob i Ob'-Irtishskogo mezhdurech'ya),
W72-02065

SALINITY

Salinity of Surface Water in the Lower Colorado River - Salton Sea Area,
W72-02074

SURFACTANTS

Development of Phosphate-Free Home Laundry Detergents,
W72-01986

SURVEY

Sewerage Practice in the Gulf Coast Area,
W72-01861

SURVEYS

Flow in a Transverse Section of Athabasca Glacier, Alberta, Canada,
W72-01708

SOIL MOISTURE SURVEY

Soil Moisture Survey, 1970-1971.
W72-01744

SUSPENDED LOAD

Distribution of Suspended Oil Particles Following the Grounding of the Tanker Arrow,
W72-02036

SUSPENDED PARTICLE INDEX

A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use,
W72-01735

SUSPENDED SEDIMENT PRODUCTION

Blue-Green Algal Effects on Some Hydrologic Processes at the Soil Surface,
W72-02218

SUSPENDED SOLIDS

Theoretical Evaluation of Filter Modeling Experiments,
W72-01859

SWIMMING

A Critical Examination of Bathing Water Quality Standards,
W72-01997

SYNOPTIC ANALYSIS

Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere,
W72-01741

SYNTHETIC RUBBER

Synthetic Rubber Canal Lining, Laboratory and Field Investigations of Synthetic Rubber Sheeting for Canal Lining - Open and Closed Conduit Systems Program,
W72-01763

SYSTEMATICS

Suggested Classification of Algae and Protozoa in Sanitary Science,

SUBJECT INDEX

SYSTEMS ANALYSIS

W72-01798

5C

W72-02013

2K

W72-02137

5G

SYSTEMS ANALYSIS

A System Analysis of Applications of Earth Orbital Space Technology to Selected Cases in Water Management and Agriculture-Volume 1, Technical Summary.

W72-02029

7B

Multireservoir Analysis Techniques in Water Quantity Studies, W72-02057

4A

Optimization in Municipal Water Supply System Design, W72-02125

6A

Comparison of Water Pricing Structures from a Collective Utility Viewpoint, W72-02233

6C

TAMPA (FLA) Standard Utilities Location. W72-01821

8A

TASTE Chemical Composition of Algae and its Relationship to Taste and Odor, W72-01812

5A

Sensory Examination of Mineralized, Chlorinated Waters, W72-01868

5F

TECHNOLOGY Thermodynamics of Environmental Degradation, W72-02137

5G

TELEMETRY New Approach to Hydrologic Data Acquisition, W72-02018

7A

A System Analysis of Applications of Earth Orbital Space Technology to Selected Cases in Water Management and Agriculture-Volume 1, Technical Summary.

W72-02029

7B

TEMPERATURE The Genesis of Sudden Stratospheric Warmings and the Quasi-Biennial Cycles, W72-02023

2B

TERRACES (GEOLOGICAL) Terraces and Pediment-Terraces in the Southwest: An Interpretation, W72-01719

2J

The Chalus Valley and its Terraces: Studies in the History and Regionalization of the Central Elburz (North Iran) (Das Chalus-Tal und Seine Terrassen, Studien Zur Landschaftsgliederung und Landschaftsgeschichte des Mit tleren Elburz, (Nordiran), W72-02207

4A

TERTIARY TREATMENT Advance Wastewater Treatment, W72-01879

5D

Reclaimed Waste Water for Groundwater Recharge, W72-02006

5D

Renovating Sewage Effluent by Ground-Water Recharge, W72-02226

5D

TEST PROCEDURES Chemical Integrating Thermometer for Water Temperature Measurement,

TEXAS

Subsurface Distribution of Nitrates Below Commercial Cattle Feedlots, Texas High Plains, W72-02003

5B

OSO Creek Technical Assistance Study: Preliminary Study on the Problems and Opportunities for Development of OSO Creek and OSO Bay.

W72-02028

6B

THEIS EQUATION

An Extended Theory of Delayed Yield from Storage Applied to Pumping Tests in Unconfined Anisotropic Aquifers, W72-02011

4B

THEORETICAL ANALYSIS

Time in Transit of Water Moving Vertically for Ground Water Recharge, W72-01750

2G

A Statistical Theory of Water Level Fluctuations in Undrained Bodies of Water (O statisticheskoy teorii kolebaniy urovney vod v besstochnykh vodoyemakh), W72-02097

2H

THERMAL PROPERTIES

Concentration Gradients in Aquifers, W72-02055

2F

THERMAL PUMPING

Concentration Gradients in Aquifers, W72-02055

2F

THERMAL STRATIFICATION

Temperature and Conductivity Measurements Under Ice Island T-3, W72-02042

2K

THERMAL WATER

The Occurrence of Thermal Ground-Water in the Basin and Range Province of Arizona, W72-02229

2F

THERMOCLINE

Some Exact Solutions to the Equations Describing an Ideal-Fluid Thermocline, W72-02032

2G

Cesium-137 in the North Atlantic Measured by Selective Absorption in Situ, W72-02084

5B

THERMODYNAMIC BEHAVIOR

Thermodynamic Properties of Water to 1,000C and 10,000 Bars, W72-02048

1A

THERMODYNAMIC PROPERTIES

Isotope Effect on the Thermodynamic Activity of Water, W72-01695

1A

THERMODYNAMICS

The Influence of Model Membrane Systems on the Structure of Water, W72-02109

3A

Solute Properties of Water-Part II, W72-02110

1A

Thermodynamics of Environmental Degradation,

W72-02084

5B

A Class of Probability Models for Littoral Drift, W72-02121

6A

TRACKING TECHNIQUES

Predicting Effects of Dead Zones on Stream Mixing,

SUBJECT INDEX

				USE RATES
W72-0183	5B	W72-01827	8A	2A
TRACTIVE FORCES				
Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation,				
W72-01727	2J			
TRANSMISSIVITY				
Transmissivity Tracts in the Coastal Plain Aquifers of Maryland,				
W72-01730	2F			
TRANSMISSION (ELECTRICAL)				
A Decade of EHV Transmission in the Soviet Union--An Annotated Bibliography,				
W72-01766	8C			
TRANSMISSION LINES				
A Study of Reinsertion Transient Voltages for Series Capacitors on USBR Glen Canyon - Flagstaff 345 KV Lines,				
W72-01775	8C			
TRASPIRATION				
Ecophysiological Studies on Plants in Arid and Semiarid Regions in Western Australia. IV. Comparison of the Field Physiology of the Host, <i>Acacia Grasbyi</i> and its Hemiparasite, <i>Amyema Nestor</i> Under Optimal and Stress Conditions,				
W72-01740	2I			
TREATMENT FACILITIES				
Island City Solves Tough Sewerage Problem.				
W72-01855	5D			
TREE-RING CHRONOLOGY				
Tree-Ring Dating of Colorado River Driftwood in the Grand Canyon,				
W72-02234	7B			
TRICKLING FILTERS				
Trickling Filter Ecology,				
W72-01819	5D			
TRITIUM				
Uranium and Tritium as Natural Tracers in the Floridan Aquifer,				
W72-01696	4B			
TROPHIC LEVEL				
Ecology of Animal Saprobia,				
W72-01799	5C			
Application of Mathematical Models to the Eutrophication Process,				
W72-01991	5B			
TROPICAL REGIONS				
A Critique of the Concept of Growing Season,				
W72-02211	3F			
TUNED TRANSMISSION				
A Decade of EHV Transmission in the Soviet Union--An Annotated Bibliography,				
W72-01766	8C			
TUNNEL CONSTRUCTION				
Effects of Temporary and Permanent Blankets on Tides and Currents in East River, Hydraulic Model Investigation,				
W72-01827	8A			
TUNNEL DESIGN				
Effects of Temporary and Permanent Blankets on Tides and Currents in East River, Hydraulic Model Investigation,				
W72-01827	8A			
TUNNELING				
Owner-Engineer-Contractor Relationships in Tunneling,				
W72-01764	8H			
Effects of Temporary and Permanent Blankets on Tides and Currents in East River, Hydraulic Model Investigation,				
W72-01827	8A			
TURBIDITY				
Optical Fourier Transform Technique for Measuring Sediment Concentration,				
W72-02158	2J			
TURBIDITY CURRENTS				
Aleutian Plain Sediments and Lithospheric Plate Motions,				
W72-02043	2J			
TURBIDITY INSTRUMENTATION				
Optical Fourier Transform Technique for Measuring Sediment Concentration,				
W72-02158	2J			
TURBULENCE				
Measurement of a Three-Dimensional Field of Water Velocities at a Depth of One Meter in an Estuary,				
W72-02015	2L			
TURBULENT FLOW				
Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation,				
W72-01727	2J			
Final Report on Control of Concentration Polarization in Reverse Osmosis Desalination of Water,				
W72-02107	3A			
TYPHOID				
Water-Borne Typhoid Epidemic at Keene, New Hampshire,				
W72-01810	5C			
ULTRAVIOLET RADIATION				
Phytoplanktonic Nitrogen as an Index of Cultural Eutrophication,				
W72-01780	5C			
UNDERGROUND GAS STORAGE				
Subsurface Storage and Disposal in Illinois,				
W72-02076	5E			
UNDERGROUND STORAGE				
Subsurface Storage and Disposal in Illinois,				
W72-02076	5E			
UNDERGROUND STRUCTURES				
Effects of Temporary and Permanent Blankets on Tides and Currents in East River, Hydraulic Model Investigation,				
W72-01827	8A			
UNIFORM FLOW				
A Uniform Flow Formula for Flumes and Canals,				
W72-02051	8B			
UNIT HYDROGRAPHS				
Determination of Nonlinear Functional Response Functions in Rainfall-Runoff Processes,				

SUBJECT INDEX

USSR

<p>W72-01980</p> <p>USSR</p> <p>Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye osvoyeniye vodnykh resursov Okskogo basseyna).</p> <p>W72-02061</p> <p>Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov basseyna r. Obi).</p> <p>W72-02062</p> <p>Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestestvennyye usloviya ulazhneniya territorii Okskogo basseyna i perspektivnyy gidromelioratsiyi).</p> <p>W72-02063</p> <p>Fish Management in the Ob River Basin in the Light of Possible Construction of the Lower Ob Hydroelectric Power Plant (Rybnoye khozyaystvo Okskogo basseyna pri uslovii sozdaniya Nizhne-Okskoy GES).</p> <p>W72-02064</p> <p>Surface-Water Resources of the Ob River and Ob-Irtish Interfluve (Resursy poverkhnostnykh vod r. Ob i Ob'-Irtishskogo mezhdurech'ya),</p> <p>W72-02065</p> <p>Long-Term Water Balance of the Irtish River in Kazakhstan (Perspektivnyy vodokhozyaystvennyy balans r. Irtisha v Kazakhstanskoy chasti),</p> <p>W72-02066</p> <p>Water and Hydroelectric Power Resources of the Upper Irtish Basin (Vodnyye i vodnoenergeticheskiye resursy basseyna Verkhnego Irtishya),</p> <p>W72-02067</p> <p>Formation of Spring Runoff in the Vasyugan'-ye (O formirovaniye vesennego stoka v usloviyakh Vasyugan'-ya),</p> <p>W72-02068</p> <p>Complex-Use Management of the Karasuk-Burla Lakes (Kompleksnoye khozyaystvennoye ispol'zovaniye Karasuksko-Burinskikh ozer),</p> <p>W72-02069</p> <p>Investigations of Moisture Exchange in the Zone of Aeration in Irrigated Land (Issledovaniya vlagooobmena v zone aeratsii na oroshayemykh zemlyakh),</p> <p>W72-02070</p> <p>Hydrologic Computational Methods for Marine Hydraulic Engineering Construction (Metody morskikh hidrologicheskikh raschetov dlya tselye hidrotekhnicheskogo stroitel'stva),</p> <p>W72-02074</p> <p>Inertial Forecast of Water Storage in Soil and its Economic Effectiveness (Inertsionnyy prognoz pochvennykh vlagozapasov i yego ekonomicheskaya effektivnost'),</p> <p>W72-02095</p> <p>USSR</p> <p>Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniya vesennego stoka i yeye realizatsiya dlya prognoza hidrografa),</p>	<p>6D</p> <p>W72-02096</p> <p>USSR</p> <p>A Statistical Theory of Water Level Fluctuations in Undrained Bodies of Water (O statisticheskoy teorii kolebaniy urovney vody v besstochnykh vodoyemakh),</p> <p>W72-02097</p> <p>Agrometeorological Conditions in the Volga Region and the Effectiveness of Measures to Combat Unfavorable Hydrometeorological Phenomena (Agrometeorologicheskiye usloviya Povolzh'ya i effektivnost' meropriyatiy po bor'be s neblagopriyatnymi gidrometeorologicheskimi yavleniyami),</p> <p>W72-02098</p> <p>Present-day and Long-term Water and Salt Balance of Southern Seas of the USSR (Azov, Caspian and Aral) and Possible Changes in Their Hydrologic and Hydrochemical Regimes (Sovremennyi i perspektivnyy vodnyy i solevoy balansy i vozmozhnyye izmeneniya hidrologicheskogo i hidrokhimicheskogo rezhimov yuzhnykh morey SSSR (Azovskogo, Kaspiskogo i Aralskogo),</p> <p>W72-02099</p> <p>Characteristics of Atmospheric Precipitation in the Southeastern Part of the West Siberian Plain (Nekotoryye osobennosti atmosfernogo ulazhneniya na yugo-vostoche Zapadno-Sibirskoy raviny),</p> <p>W72-02100</p> <p>Problems in the Irrigation of the Kulunda Steppe (Nekotoryye voprosy orosheniya Kulundinskoy stepi),</p> <p>W72-02101</p> <p>Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektivnyy ispol'zovaniye podzemnykh vod yugovostochnoy chasti Zapadnoy Sibiri),</p> <p>W72-02102</p> <p>Effect of Water Losses from Irrigation Canals on Groundwaters of the Aleysk Irrigation System (Vliyanie poter' vody iz orositel'nykh kanalov na gruntovyye vody Aleyskoy orositel'noy sistemy),</p> <p>W72-02103</p> <p>Estimated Return Periods for Short-Duration Precipitation in Utah,</p> <p>W72-02026</p> <p>UTAH</p> <p>Operating Experiences with Vacuum Filtration at St. Helens: A Solution to the Problem,</p> <p>W72-01849</p> <p>VACUUM DRYING</p> <p>The Effects of Acid Mine Pollution on the Fish Population of Goose Creek, Clay County, Kentucky,</p> <p>W72-01806</p> <p>WATER</p> <p>Isotope Effect on the Thermodynamic Activity of Water,</p> <p>W72-01695</p> <p>VARIABILITY</p> <p>Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere,</p> <p>W72-01741</p> <p>WALKER CIRCULATION</p> <p>Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere,</p> <p>W72-01727</p> <p>WASTE ASSIMILATIVE CAPACITY</p> <p>Oxygen Diffusion Through a Pure Culture Floc of Zoogloea Ramigera,</p>	<p>2E</p> <p>W72-01741</p> <p>Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States, W72-02210</p> <p>VEGETATION</p> <p>The Chalus Valley and its Terraces: Studies in the History and Regionalization of the Central Elbur (North Iran) (Das Chalus-Tal und Seine Terrassen, Studien Zur Landschaftsgliederung und Landschaftsgeschichte des Mit thieren Elburs, (Nordiran), W72-02207</p> <p>VEGETATION EFFECTS</p> <p>Some Geographic Implications of Water-Repellent Soils,</p> <p>W72-01745</p> <p>VEGETATION REGROWTH</p> <p>Economic Evaluation of Some Watershed Management Alternatives on Forest Land in West Virginia,</p> <p>W72-02146</p> <p>VIRAL INACTIVATION</p> <p>Virus Inactivation During Phosphate Precipitation,</p> <p>W72-01852</p> <p>VIRGINIA</p> <p>Bedrock Weathering and Residual Soil Formation in Central Virginia,</p> <p>W72-01716</p> <p>VIRUSES</p> <p>Virus Inactivation During Phosphate Precipitation,</p> <p>W72-01852</p> <p>VISCOUS FLOW</p> <p>Dynamic Fluid Loss During Viscous Flow Through a Porous Vertical Slot,</p> <p>W72-02060</p> <p>VOLCANOES</p> <p>Some Aspects of the Geochemistry of F, Fe and Mn in Coastal Waters and in Fresh-Water Springs on the Southeast Coast of Hawaii,</p> <p>W72-01998</p> <p>The Origin of Metal-Bearing Submarine Hydrothermal Solutions,</p> <p>W72-02044</p> <p>VORTICES</p> <p>Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation,</p> <p>W72-01727</p> <p>WALKER CIRCULATION</p> <p>Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere,</p> <p>W72-01741</p> <p>WASTE ASSIMILATIVE CAPACITY</p> <p>Oxygen Diffusion Through a Pure Culture Floc of Zoogloea Ramigera,</p>
--	---	--

SUBJECT INDEX

WATER CHEMISTRY

W72-01851	SD	W72-01786	5C	W72-01877	SD
WASTE DILUTION			Effect of Filter Cloth Structure on Flow Resistance, Bleeding, Blinding and Plant Performance,		
Management of Artificial Recharge Wells for Groundwater Quality Control, W72-02228			W72-01878		
5G			5D		
WASTE DISPOSAL			Advance Wastewater Treatment,		
Aquatic Organisms as an Aid in Solving Waste Disposal Problems, W72-01801			W72-01879		
5C			5D		
The De-Watering of Digested Sludge Using Synthetic Filtering Agents, W72-01846			Viability of Long-Stored Airborne Bacterial Aerosols,		
5E			W72-01882		
Radioactive Wastes-Their Treatment and Disposal,			Biological Treatment of Strong Industrial Waste from a Fiberboard Factory,		
W72-01871			W72-01885		
5D			5D		
Subsurface Disposal of Liquid Industrial Wastes in Alabama-A Current status Report, W72-02075			Virus Removal by Coagulation with Polyelectrolytes,		
5E			W72-01886		
Vessel and Aircraft Garbage, W72-02122			Colloid Flotation and Adsorbing Colloid Flotation,		
6E			W72-02105		
Disposal of Refuse or Dead Animals, W72-02123			Renovating Sewage Effluent by Ground-Water Recharge,		
6E			W72-02226		
WASTE DISPOSAL WELLS			WATER ALLOCATION (POLICY)		
Subsurface Disposal of Liquid Industrial Wastes in Alabama-A Current status Report, W72-02075			Concepts Used as Economic Criteria for a System of Water Rights,		
5E			W72-02148		
Subsurface Storage and Disposal in Illinois, W72-02076			Physiographic Limitations upon the Use of Southwestern Rivers,		
5E			W72-02235		
WASTE STORAGE			WATER BALANCE		
Vessel and Aircraft Garbage, W72-02122			Corrective Terms in the Glaciological Balance,		
6E			W72-01715		
WASTE TREATMENT			Drought Influence on Physiological Processes and Subsequent Growth,		
The Chemistry and Biology of Milk Waste Disposal, W72-01816			W72-01758		
5D			Psychrometric Determination of Water Potential of Desert Plants,		
W72-01786			W72-01761		
WASTE WATER DISPOSAL			Water Exchange at the Mouth of the Gulf of California,		
Biology of Water Pollution: A Collection of Selected Papers on Stream Pollution, Waste Water, and Water Treatment, W72-01786			W72-02041		
5C			Formation of Spring Runoff in the Vasyugan'-ye (O formirovani vesennego stoka v usloviyah Vasyugan'ya),		
Preliminary Study of the Development of Water Resources of the Humacao Sub-region, Puerto Rico, W72-01829			W72-02068		
6D			4A		
Inventory and Problem Delineation, Phase I Report, Regional Water Supply and Wastewater Disposal Study, W72-01830			Present-day and Long-term Water and Salt Balance of Southern Seas of the USSR (Azov, Caspian and Aral) and Possible Changes in Their Hydrologic and Hydrochemical Regimes (Sovremennyi i perspektivnyi vodnyi i solevoy balansy i vozmozhnye izmeneniya gidrologicheskogo i hidrokhimicheskogo rezhimov yuzhnykh morey SSSR (Azovskogo, Kaspiyskogo i Aral'skogo),		
6D			W72-02099		
Disposal of Nitrogenous Liquid Effluent From Modderfontein Dynamite Factory, W72-01866			2H		
5D			Characteristics of Atmospheric Precipitation in the Southeastern Part of the West Siberian Plain (Nekotorye osobennosti atmosfernogo uvlazhneniya na yugo-vostoke Zapadno-Sibirskoy raviny),		
Effect of Sulfate and Other Ions in Coagulation with Aluminum, W72-01869			W72-02100		
5D			2B		
Subsurface Disposal of Liquid Industrial Wastes in Alabama-A Current status Report, W72-02075			WATER CHEMISTRY		
5E			Saline Waters: Genesis and Relationship to Sediments and Host Rocks,		
Subsurface Storage and Disposal in Illinois, W72-02076					
5E					
WASTE WATER TREATMENT					
Biological Treatment of Beef Animal Wastes, W72-01777					
5D					
Biology of Water Pollution: A Collection of Selected Papers on Stream Pollution, Waste Water, and Water Treatment.					

SUBJECT INDEX

WATER CHEMISTRY

W72-0175	2K	W72-01833	3A	W72-01791
Some Aspects of the Geochemistry of F, Fe and Mn in Coastal Waters and in Fresh-Water Springs on the Southeast Coast of Hawaii, W72-01998	2K	WATER LEVEL FLUCTUATIONS Tidal Choking, W72-01725	2L	Complex-Use Management of the Karasuk-Buria Lakes (Kompleksnoye khozyaystvennoye ispol'zovaniye Karasuksko-Burinskikh ozer), W72-02069
Permafrost-Hydrogeologic Regimen in Two Ice-Free Valleys, Antarctica, from Electrical Depth Sounding, W72-02030	2C	Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals, W72-01781	2F	4A
The Origin of Metal-Bearing Submarine Hydrothermal Solutions, W72-02044	2K	A Statistical Theory of Water Level Fluctuations in Undrained Bodies of Water (O statisticheskoy teorii kolebanii urovney vod v besstochnykh vodoyemakh), W72-02097	2H	6E
The Use of Chemical Hydrographs in Ground-water Quality Studies, W72-02225	5A	WATER LEVELS Annual Water Statement, 1970-1971, W72-01743	4B	WATER POLLUTION CONTROL Biology of Water Pollution: A Collection of Selected Papers on Stream Pollution, Waste Water, and Water Treatment, W72-01786
WATER CIRCULATION Analytical Solution for the Wind-Driven Circulation in a Lake Containing an Island, W72-02022	2H	Overpumped Artesian Wells Among a Well Group, W72-02005	4B	5C
WATER CONSERVATION Lysimetric and Energy Balance Determination of Slatfence and Tree Windbreak Effects on Water Use Efficiency, W72-01748	2D	WATER LOSS Effect of Water Losses from Irrigation Canals on Groundwaters of the Aleysk Irrigation System (Vliyanie poter' vody iz orositel'nykh kanalov na gruntovye vody Aleyskoy orositel'noy sistemy), W72-02103	3F	Petroleum Contamination of Ground Water in Maryland, W72-02080
Effective Drought Control for Successful Dry-land Agriculture, W72-01759	3F	WATER MANAGEMENT (APPLIED) A Methodology Study to Develop Evaluation Criteria for Wild and Scenic Rivers: Landowner Perception of Recreationist Associated Conflicts in the Salmon-Little Salmon River Corridor of Idaho, W72-01746	6B	Vessel and Aircraft Garbage, W72-02122
Comparison of Water Pricing Structures from a Collective Utility Viewpoint, W72-02233	6C	A System Analysis of Applications of Earth Orbital Space Technology to Selected Cases in Water Management and Agriculture-Volume 1, Technical Summary, W72-02029	7B	Validation of Political Simulation Models - Water Resource Projects, W72-02129
WATER CONSUMPTION (EXCLUDES CONSUMPTIVE USE) Long-Term Water Balance of the Irtysh River in Kazakhstan (Perspektivnyy vodokhozyaystvennyy balans r. Irtysha v Kazakhstanskoy chasti), W72-02066	4A	Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye osvoyeniye vodnykh resursov Obskogo basseyna), W72-02061	4A	Pollution Control Act, W72-02139
WATER COSTS Economic Evaluation of Some Watershed Management Alternatives on Forest Land in West Virginia, W72-02146	4A	Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov basseyna r. Obi), W72-02062	4A	6E
WATER DEMAND Determining the Demand and Economic Value for the Water-Based Outdoor Recreation Resources at Lake MacBride State Park in the Summer of 1970, W72-01980	6D	Complex-Use Management of the Karasuk-Buria Lakes (Kompleksnoye khozyaystvennoye ispol'zovaniye Karasuksko-Burinskikh ozer), W72-02069	4A	A Weiter of Ideas--A Modicum of Coordination, W72-02151
Long-Term Water Balance of the Irtysh River in Kazakhstan (Perspektivnyy vodokhozyaystvennyy balans r. Irtysha v Kazakhstanskoy chasti), W72-02066	4A	Water Resources, W72-02144	6E	Orsanco--1970, W72-02152
WATER DISTRIBUTION (APPLIED) Standard Utilities Location, W72-01821	8A	WATER POLICY Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1, W72-01979	6E	National Water Quality Standards Act of 1971, W72-02154
Minimum Design Standards for Community Water Supply Systems (Existing standard--FHA 4517.1) (Draft environmental statement), W72-01822	5F	WATER POLLUTION Biology of Water Pollution: A Collection of Selected Papers on Stream Pollution, Waste Water, and Water Treatment, W72-01786	5C	Industry/Government Teleconference on Pollution Control, W72-02155
WATER DISTRICTS Public Utilities--Water Authorities, W72-02145	6E	Biological Indices of Water Pollution with Special Reference to Fish Population, W72-01786	5C	WATER POLLUTION CONTROL ACT National Water Quality Standards Act of 1971, W72-02154
WATER FLUX Imprived Membranes for Reverse Osmosis,				5G

SUBJECT INDEX

WATER QUALITY CONTROL

W72-01804	5C	W72-02078	5B	W72-01773	5F	
The Effects of Sewage Pollution on the Fish Population of a Midwestern Stream, W72-01805			5C	Biological Assays and Water Quality in Minnesota, W72-01783		
The Effects of Acid Mine Pollution on the Fish Population of Goose Creek, Clay County, Kentucky, W72-01806			5C	Ecology of Animal Saprobia, W72-01799		
Water Pollution, Its Effect on Public Health, W72-01808			5C	Water Quality Requirements for Recreational Uses, W72-01807		
Model Studies of Outfall Systems for Desalination Plants (Part I - Flume Study), W72-01838			5E	Improving Municipal Water Supplies in Colorado by Desalting, W72-01839		
Oxygen Requirements of Some Marine and Anadromous Fishes, with Particular Reference to Problems of Measurement, W72-01875			5C	Reevaluation of Prado Water Quality Objectives, W72-01850		
Water Quality Investigations, Souris River Basin, North Dakota - 1969. W72-01992			5B	A Critical Examination of Bathing Water Quality Standards, W72-01997		
The Anacostia River, Ecological Imbalance of an Urban Stream Valley, W72-02093			5C	Salinity of Surface Water in the Lower Colorado River - Salton Sea Area, W72-02074		
WATER POLLUTION SOURCES				Comparison of Plant Water Quality to Proposed Water Quality Standard, W72-02082		
Aquatic Life in Waters Polluted by Acid Mine Waste, W72-01796			5C	WATER QUALITY ACT		
Chemical Composition of Algae and its Relationship to Taste and Odor, W72-01812			5A	Economics and Politics in Water Pollution Control, W72-02135		
Aquatic Biology and the Water Works Engineer, W72-01813			5C	WATER QUALITY CONTROL		
Industrial Wastes as a Source of Tastes and Odors in Water Supplies, W72-01815			5C	Control of Benthic Deposits in Lakes, W72-01699		
Relationship Between Escherichia Coli, Type I and Enterococci in Water, W72-01854			5B	Pilot Mechanical Aeration Studies of the Jackson River in Covington, West Virginia, W72-01845		
Characteristics and Pollution Problems of Irrigation Return Flow. W72-01984			5B	Chemical Aspects of Some Waste Disposal Problems, W72-01872		
Water Quality Investigations, Souris River Basin, North Dakota - 1969. W72-01992			5B	Model for Flow Augmentation Analysis-An Overview, W72-01874		
Mercury Pollution: Michigan's Action Program, W72-01995			5B	The Prevention of Pollution in Estuaries, W72-01883		
Natural Relationships of Indicator and Pathogenic Bacteria in Stream Waters, W72-01996			5B	Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1, W72-01979		
Subsurface Distribution of Nitrates Below Commercial Cattle Feedlots, Texas High Plains, W72-02003			5B	Characteristics and Pollution Problems of Irrigation Return Flow. W72-01984		
Microwave Radiometric Detection of Oil Slicks, W72-02024			5A	Disposal of Refuse or Dead Animals. W72-02123		
Gas-Phase Catalytic Oxidation of Phenol in Dilute Concentrations with Water Vapor, W72-02050			5D	Objectives and Methods of Data Processing and Analysis in the Water Treatment Context, W72-02128		
Pesticide contamination of a Shallow Bored Well in the Southeastern Coastal Plains,				Pollution Control Act. W72-02139		
				A Bill to Amend the Federal Water Pollution Control Act to Provide Financial Assistance for River Basin Programs. W72-02141		
				A Welter of Ideas--A Modicum of Coordination,		

WATER QUALITY CONTROL

SUBJECT INDEX

W72-02151	5G	W72-02028	6B	W72-02006
National Water Quality Standards Act of 1971.		A System Analysis of Applications of Earth Orbital Space Technology to Selected Cases in Water Management and Agriculture-Volume 1, Technical Summary.		Feasibility of Recharging Treated Sewage Effluent into a Deep Sandstone Aquifer, W72-02077
W72-02154	5G			5D
WATER QUANTITY				
Multireservoir Analysis Techniques in Water Quantity Studies, W72-02057	4A	Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye osvoeniyie vodnykh resursov Obskogo basseyna).	7B	Agricultural Utilization of Sewage Effluent and Sludge, an Annotated Bibliography, W72-02104
		W72-02029		5G
WATER-REPELLENT SOILS				
Some Geographic Implications of Water-Repellent Soils, W72-01745	2G	Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov basseyna r. Obi), W72-02061	4A	WATER SOURCES
Effects of Fire on Water Infiltration Rates in a Ponderosa Pine Stand, W72-02219	2G	Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov basseyna r. Obi), W72-02062	4A	Optimal Utilization of Playa Lake Water in Irrigation, W72-02231
		W72-02063		3F
WATER REQUIREMENTS				
Long-Term Water Balance of the Irtysh River in Kazakhstan (Perspektivnyy vodokhozyaystvennyy balans r. Irtysha v Kazakhstanskoy chasti), W72-02066	4A	Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestestvennyye usloviya uvlazhneniya territorii Obskogo basseyna i perspektivnyy gidromelioratsiyi), W72-02063	4A	WATER SUPPLY
		W72-02064		Water-Borne Typhoid Epidemic at Keene, New Hampshire, W72-01810
WATER RESOURCES				5C
Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov Obskogo basseyna), W72-02061	4A	Fish Management in the Ob River Basin in the Light of Possible Construction of the Lower Ob Hydroelectric Power Plant (Rybnoye khozyaystvo Obskogo basseyna pri uslovii sozdaniya Nizhne-Obskoy GES), W72-02064	4A	Aquatic Biology and the Water Works Engineer, W72-01813
Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov basseyna r. Obi), W72-02062	4A	A Preliminary Evaluation of Hydrologic Conditions of the Lakeland Ridge Area of Polk County, Florida, W72-02086	4B	Pre-Treatment Basin for Algae Removal, W72-01814
Surface-Water Resources of the Ob River and Ob-Irtysh Interfluve (Resursy poverkhnostnykh vod r. Ob i Ob'-Irtyshskogo mezhdurech'ya), W72-02065	4A	Ground-Water Exploration, Beaver Creek Valley Near Kenai, Alaska, W72-02087	4B	Industrial Wastes as a Source of Tastes and Odors in Water Supplies, W72-01815
Long-Term Water Balance of the Irtysh River in Kazakhstan (Perspektivnyy vodokhozyaystvennyy balans r. Irtysha v Kazakhstanskoy chasti), W72-02066	4A	Hydrologic Effects of Water Control and Management of Southeastern Florida, W72-02090	4A	Minimum Design Standards for Community Water Supply Systems (Existing standard-FHA 4517.1) (Draft environmental statement), W72-01822
		W72-02099		5F
Water and Hydroelectric Power Resources of the Upper Irtysh Basin (Vodnyye i vodnoenergeticheskiye resursy basseyna Verkhnego Irtysha), W72-02067	4A	Present-day and Long-term Water and Salt Balance of Southern Seas of the USSR (Azov, Caspian and Aral) and Possible Changes in Their Hydrologic and Hydrochemical Regimes (Sovremennyyi i perspektivnyy vodnyy i solevoy balansy i vozmozhnyye izmeneniya gidrologicheskogo i hidrokhimicheskogo rezhimov yuzhnykh morey SSSR (Azovskogo, Kaspiyskogo i Aralskogo), W72-02099	2H	Preliminary Study of the Development of Water Resources of the Humacao Sub-region, Puerto Rico, W72-01829
Complex-Use Management of the Karasuk-Burla Lakes (Kompleksnoye khozyaystvennoye ispol'zovaniye Karasuksko-Burlianskikh ozer), W72-02069	4A	Concepts Used as Economic Criteria for a System of Water Rights, W72-02148	6E	Inventory and Problem Delineation, Phase I Report, Regional Water Supply and Wastewater Disposal Study, W72-01830
Digital Simulation of an Existing Water Resources System, W72-02132	6A	South Africa and Its Water Problem (L'Afrique du Sud et le Probleme de L'eau), W72-02209	4A	Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1, W72-01979
1970 Literature Review, Administration: Economics, W72-02140	6B	Use and Abuse of Southwestern Rivers. The Pueblo Dweller, W72-02236	3F	Ground Water for Irrigation in the Brooten-Belgrade Area, West-Central Minnesota, W72-02071
Water Resources, W72-02144	6E	Use and Abuse of Southwestern Rivers. Historic Man-The Anglo, W72-02238	4A	Public Utilities--Water Authorities, W72-02145
WATER RESOURCES DEVELOPMENT				6E
Enhancement of Ecologic and Aesthetic Values of Water Associated with Interstate Highways, W72-01698	4C	WATER REUSE		
OSO Creek Technical Assistance Study: Preliminary Study on the Problems and Opportunities for Development of OSO Creek and OSO Bay.		Wastewater Treatment and Re-Use of Treated Sewage as an Industrial Water Supply, W72-01860	5D	WATER TEMPERATURE
		Reclaimed Waste Water for Groundwater Recharge,		Temperature Requirements for Growth and Survival of Larval Ciscos (Coregonus Arted II), W72-01989
				5C
				Chemical Integrating Thermometer for Water Temperature Measurement,

SUBJECT INDEX

WEST SIBERIA

<p>W72-02013 2K</p> <p>WATER TRANSFER Limitation on Diversion From the Watershed: Riparian Roadblock to Beneficial Use, W72-02149 6E</p> <p>WATER TREATMENT Water Pollution, Its Effect on Public Health, W72-01808 5C</p> <p>Improving Municipal Water Supplies in Colorado by Desalting, W72-01839 3A</p> <p>The Biochemical Aspects of Aerobic Bacterial Growth, W72-01870 5F</p> <p>Virus Removal by Coagulation with Polyelectrolytes, W72-01886 5F</p> <p>Objectives and Methods of Data Processing and Analysis in the Water Treatment Context, W72-02128 6A</p> <p>WATER USE EFFICIENCY A Critique of the Concept of Growing Season, W72-02211 3F</p> <p>WATER USERS Reevaluation of Prado Water Quality Objectives, W72-01850 5G</p> <p>WATER UTILIZATION Long-Term Water Balance of the Irtysh River in Kazakhstan (Perspektivnyy vodokhozyaistvennyy balans r. Irtysha v Kazakhstanskoy chasti), W72-02066 4A</p> <p>Water and Hydroelectric Power Resources of the Upper Irtysh Basin (Vodnyye i vodnoenergeticheskiye resursy basseyna Verkhnego Irtysha), W72-02067 4A</p> <p>WATER VAPOR Gas-Phase Catalytic Oxidation of Phenol in Dilute Concentrations with Water Vapor, W72-02050 5D</p> <p>WATER WELLS Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals, W72-01781 2F</p> <p>Pesticide contamination of a Shallow Bored Well in the Southeastern Coastal Plains, W72-02078 5B</p> <p>Gasoline Pollution of a Ground-Water Reservoir -- A Case History, W72-02079 5B</p> <p>Ground-Water Exploration, Beaver Creek Valley Near Kenai, Alaska, W72-02087 4B</p> <p>WATER YIELD Hydrologic Factors in the Determination of Watershed Yields, W72-01700 2A</p> <p>An Extended Theory of Delayed Yield from Storage Applied to Pumping Tests in Unconfined Anisotropic Aquifers,</p>	<p>W72-02011 4B</p> <p>Multireservoir Analysis Techniques in Water Quantity Studies, W72-02057 4A</p> <p>Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks in Central Pennsylvania, W72-02115 4B</p> <p>WATER YIELD IMPROVEMENT Progress in Developing Forest Management Guidelines for Increasing Snowpack Water Yields, W72-02230 4A</p> <p>WATERCOURSES (LEGAL) What Constitutes Natural Drainway or Watercourse for Flow of Surface Water, W72-02156 6E</p> <p>Periodical, Seasonal, or Intermittent Stream as a Watercourse, W72-02157 6E</p> <p>WATERSHED MANAGEMENT Hydrologic Characterization of Forested Watersheds in Arizona, W72-01703 2A</p> <p>OSO Creek Technical Assistance Study: Preliminary Study on the Problems and Opportunities for Development of OSO Creek and OSO Bay, W72-02028 6B</p> <p>Economic Evaluation of Some Watershed Management Alternatives on Forest Land in West Virginia, W72-02146 4A</p> <p>WATERSHEDS Reevaluation of Prado Water Quality Objectives, W72-01850 5G</p> <p>Nitrogen Balance For a 23 Square Mile Minnesota Watershed, W72-02216 2K</p> <p>Effects of Fire on Water Infiltration Rates in a Ponderosa Pine Stand, W72-02219 2G</p> <p>The Use of a Realistic Rainfall Simulator to Determine Relative Infiltration Rates of Contributing Watersheds to the Lower Gila Below Painted Rock Dam, W72-02220 2G</p> <p>WATERSHEDS (BASINS) Hydrologic Factors in the Determination of Watershed Yields, W72-01700 2A</p> <p>Limitation on Diversion From the Watershed: Riparian Roadblock to Beneficial Use, W72-02149 6E</p> <p>WAVES (WATER) Transient Motions induced by Local Disturbances in a Linearly Density-Stratified Fluid, W72-01726 2E</p> <p>WAVES (WATER) Measurement of a Three-Dimensional Field of Water Velocities at a Depth of One Meter in an Estuary,</p>	<p>W72-02015 2L</p> <p>WAVES (WATER) Seiche Motions for a Basin of Rectangular Plan and of Nonuniform Depth, W72-02031 2E</p> <p>Observations on Short-Period Internal Waves in Massachusetts Bay, W72-02035 2L</p> <p>WEATHER The Genesis of Sudden Stratospheric Warnings and the Quasi-Biennial Cycles, W72-02023 2B</p> <p>WEATHER FORECASTING The Genesis of Sudden Stratospheric Warnings and the Quasi-Biennial Cycles, W72-02023 2B</p> <p>WEATHER MODIFICATION Complexes of Silver Iodide and Secondary Amines, W72-02072 3B</p> <p>WEATHER PATTERNS The Genesis of Sudden Stratospheric Warnings and the Quasi-Biennial Cycles, W72-02023 2B</p> <p>WEATHERING Bedrock Weathering and Residual Soil Formation in Central Virginia, W72-01716 2J</p> <p>Chemical Weathering of the Biscayne Aquifer, Dade County, Florida, W72-01731 2F</p> <p>WEIRS Linear Proportional Weirs with Trapezoidal Bottoms, W72-01728 8B</p> <p>Shapes of Grit Chambers to Achieve Certain Velocity-Head Relations with given Shapes of Outlet Weirs, W72-01729 8B</p> <p>WELL INTERFERENCE Overpumped Artesian Wells Among a Well Group, W72-02005 4B</p> <p>WELL REGULATIONS Requirement for the Capping of Certain Artesian Wells, W72-02186 6E</p> <p>WELLS Public Utilities-Water Authorities, W72-02145 6E</p> <p>WEST SIBERIA Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye osvoyeniye vodnykh resursov Okskogo basseyna), W72-02061 4A</p> <p>Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov basseyna r. Obi), W72-02062 4A</p> <p>Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestestvennyye usloviya uvlazhneniya territorii Okskogo basseyna i perspektivnyye gidromelioratsiyi),</p>
--	--	---

SUBJECT INDEX

WEST SIBERIA

W72-02063	4A
Fish Management in the Ob River Basin in the Light of Possible Construction of the Lower Ob Hydroelectric Power Plant (Rybnoye khozyaystvo Obskogo basseyna pri uslovii sozdaniya Nizhne-Obskoy GES),	
W72-02064	4A
Surface-Water Resources of the Ob River and Ob-Irtysh Interflue (Resursy poverkhnostnykh vod r. Obi i Ob'-Irtyshskogo mezhdurech'ya),	
W72-02065	4A
Long-Term Water Balance of the Irtysh River in Kazakhstan (Perspektivnye vodokhozyaystvennye balans r. Irtysha v Kazakhstanskoy chasti),	
W72-02066	4A
Water and Hydroelectric Power Resources of the Upper Irtysh Basin (Vodnyye i vodnoenergeticheskiye resursy basseyna Verkhnego Irtysha),	
W72-02067	4A
Formation of Spring Runoff in the Vasyugan'-ye (O formirovaniyu vesennego stoka v usloviyakh Vasyugan'ya),	
W72-02068	4A
Complex-Use Management of the Karasuk-Burla Lakes (Kompleksnoye khozyaystvennoye ispol'zovaniye Karasuksko-Burlinskikh ozer),	
W72-02069	4A
Investigations of Moisture Exchange in the Zone of Aeration in Irrigated Land (Issledovaniya vlagooobmena v zone aeratsii na oroshayemykh zemlyakh),	
W72-02070	4A
Characteristics of Atmospheric Precipitation in the Southeastern Part of the West Siberian Plain (Nekotoryye osobennosti atmosfernogo uvlazhneniya na yugo-vostoche Zapadno-Sibirskoy raviny),	
W72-02100	2B
Problems in the Irrigation of the Kulunda	

Steppe (Nekotoryye voprosy orosheniya Kulundinskoy stepi),	3F
W72-02101	3F

Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektivnye ispol'zovaniya podzemnykh vod yugovostochnoy chasti Zapadnoy Sibiri),	4B
W72-02102	4B

Effect of Water Losses from Irrigation Canals on Groundwaters of the Aleysk Irrigation System (Vliyanie poter' vody iz orositel'nykh kanalov na gruntovyye vody Aleyskov orositel'noy sistemy),	3F
W72-02103	3F

WEST VIRGINIA

Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia,	2B
W72-02025	2B

WETLANDS

Enhancement of Ecologic and Aesthetic Values of Water Associated with Interstate Highways,	4C
W72-01698	4C

WINDBREAKS

Lysimetric and Energy Balance Determination of Slatfence and Tree Windbreak Effects on Water Use Efficiency,	2D
W72-01748	2D

WINDS

Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere,	2B
W72-01741	2B

Analytical Solution for the Wind-Driven Circulation in a Lake Containing an Island,	2H
W72-02022	2H

WINTER COMMERCE

Winter Commerce on the Baltic: Some Implications on Opening the Great Lakes,	6B
W72-02143	6B

WISCONSIN

Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1,	6E
W72-01979	6E

WITHDRAWAL

Ground Water for Irrigation in the Brooten-Belgrade Area, West-Central Minnesota,	4B
W72-02071	4B

WYOMING

Disposal of Refuse or Dead Animals,	6E
W72-02123	6E

X-RAY ANALYSIS

Complexes of Silver Iodide and Secondary Amines,	3B
W72-02072	3B

XEROPHYTES

Psychrometric Determination of Water Potential of Desert Plants,	2I
W72-01761	2I

YAHARA RIVER (WIS)

A Heavy Mortality of Fishes Resulting from the Decomposition of Algae in the Yahara River, Wisconsin,	5C
W72-01797	5C

ZINC

Water Geochemistry of Mining and Milling Retention in the 'New Lead Belt' of Southeast Missouri,	5B
W72-01692	5B

ZONE OF AERATION

Investigations of Moisture Exchange in the Zone of Aeration in Irrigated Land (Issledovaniya vlagooobmena v zone aeratsii na oroshayemykh zemlyakh),	4A
W72-02070	4A

ZOOGLEAL SLIME

Trickling Filter Ecology,	5D
W72-01819	5D

ZOOGLOEA RAMIGERA

Oxygen Diffusion Through a Pure Culture Floc of Zoogloea Ramigera,	5D
W72-01851	5D

AUTHOR INDEX

AARKROG, A. Radioecological Investigations of Plutonium in an Arctic Marine Environment, W72-01884	5B	W72-01772	3F	W72-01782	2G
ABDUL BHUKARI, C. H. Linear Proportional Weirs with Trapezoidal Bottoms, W72-01728	8B	ALLUM, M. O. Biological Factors in Treatment of Raw Sewage in Artificial Ponds, W72-01818	5D	BABCOCK, R. E. Dynamic Fluid Loss During Viscous Flow Through a Porous Vertical Slot, W72-02060	8B
ABEL, G. A. Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02159	5B	AMOROCHO, J. Determination of Nonlinear Functional Response Functions in Rainfall-Runoff Processes, W72-02116	2A	BABCOCK, RUSSELL H. A Rational Evaluation of Instrumentation and Control Systems, W72-01823	5D
Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02160	5B	ANDEL, J. Analysis of Periodicity in Hydrological Sequences, W72-02012	2A	BACK, W. Geochemical Interpretations of Groundwater Flow Systems, W72-02007	2K
ABRAHAM, G. Discontinuities in Stratified Flows, W72-01723	2E	ANDERSON, D. J. Pattern in Desert Perennials, W72-01760	2I	BAIER, D. C. Reclaimed Waste Water for Groundwater Recharge, W72-02006	5D
ADAMOWSKI, K. Spectral Density of a River Flow Time Series, W72-02010	2E	ANDERSON, G. S. Ground-Water Exploration, Beaver Creek Valley Near Kenai, Alaska, W72-02087	4B	Reevaluation of Prado Water Quality Objectives, W72-01850	5G
ADAMS, GEORGE F. Soluble Carbohydrates as a Factor Influencing Gross Primary Productivity and Bacterial Populations in Lakes, W72-01938	2H	ANSELL, G. B. Complexes of Silver Iodide and Secondary Amines, W72-02072	3B	BALDWIN, R. E. Sensory Examination of Mineralized, Chlorinated Waters, W72-01868	5F
ADAMS, J. R. Drag Forces on Baffle Blocks in Hydraulic Jumps, W72-02019	8B	ANTILL, J. Validation of Political Simulation Models - Water Resource Projects, W72-02129	6A	BALEK, J. Analysis of Periodicity in Hydrological Sequences, W72-02012	2A
AGARDY, F. J. Improving Municipal Water Supplies in Colorado by Desalting, W72-01839	3A	APGAR, M. A. Ground-Water Pollution Potential of a Landfill above the Water Table, W72-02081	5B	BALOCH, M. S. Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia, W72-02025	2B
AHLGREN, GUNNEL Limnological Studies of Lake Norrviken, A Eutrophicated Swedish Lake: II. Phytoplankton and Its Production, W72-02199	5C	ARESHIDZE, I. V. Dynamics of Changes in Chemical Composition of Green Algae of the Black Sea, (In Russian), W72-01920	2L	BARAKAT, M. A. Effect of Some Soil Properties on Root and Top Growth and Mineral Content of 'Washington' Naval Orange and 'Balady' Mandarin, W72-01891	2I
AKHINYAN, G. M. Some Necessary Measures in Unirrigated Afforestation in the Armenian SSR (In Russian), W72-01901	4A	ARMSTRONG, D. E. Characterization of Inorganic Phosphate in Noncalcareous Lake Sediments, W72-02113	2H	BARAN, N. E. A Stochastic Analysis of Flows on Rillito Creek, W72-02224	2E
ALBERTS, J. J. Organic-Inorganic Associations: Their Formation and Involvement in Nutrient Mobilization from the Sediments of Lakes, W72-02053	2H	ARMSTRONG, E. L. Owner-Engineer-Contractor Relationships in Tunneling, W72-01764	8H	BARASHKOVA, E. A. Photosynthesis in Fruticose Lichens Cladonia Alpestris (L.) Rabh. and C. rangiferina (L.) Web. in the Taimyr Peninsula, (In Russian), W72-01921	2I
ALEXANDER, D. Potentiometric Techniques for Monitoring Ions Involved in Water Pollution, W72-01693	5A	ARNOLD, E. L. Drying Rates of Bird'sfoot Trefoil Seed, W72-02089	3F	BARKLEY, P. W. Secondary Economic Effects of Irrigation on the Colorado High Plains, W72-02136	6B
ALI, S. A. Influence of Soil Moisture on Growth, Yield and Quality of Groundnut, W72-01962	3F	ASHMAN, P. S. Operating Experiences with Vacuum Filtration at St. Helens: A Solution to the Problem, W72-01849	5D	BARNES, D. L. Runoff and Soil Loss on a Sand Veld in Rhodesia, W72-02240	2G
ALIPOUR, H. Comparative Study of Italian Polyploid Varieties of Beets Used in Fodder, Cultivated without Irrigation (In Bulgarian), W72-01974	3F	ASHTON, G. D. Two Investigations of River Ice: Part I and Part 2, W72-02056	2C	BARRACK, T. J. Coastal Zone Management--The Tidelands: Legislative Apathy Vs. Judicial Concern, W72-02153	6E
ALLEN, WILLIAM A. Water and Air Changes in Grapefruit, Corn, and Cotton Leaves with Maturation,		ASIKAINEN, A. P. Control of Benthic Deposits in Lakes, W72-01699	2H	BARRETT, A. H. A Stable Spar-Buoy Platform for Mounting Instrumentation,	

AUTHOR INDEX

BARSCH, D.

W72-02039	7B	W72-01934	2L	W72-02187	2D
BARSCH, D.					
Terraces and Pediment-Terraces in the Southwest: An Interpretation, W72-01719	2J	BEERS, JOHN R.		BLUE, W. G.	
		A Permanent record of Plankton Samples Using Holography, W72-02202	2I	Nutritive Value of Fertilized Jaragua Grass (<i>Hyparrhenia Rufa</i> (Nees) Stapf.) in the Wet-Dry Pacific Region of Costa Rica, W72-01975	3F
BARTSCH, A. F.					
Biological Aspects of Stream Pollution, W72-01789	5C	BELLA, DAVID A.		BOBB, W. H.	
Biological Factors in Treatment of Raw Sewage in Artificial Ponds, W72-01818	5D	Dissolved Oxygen Variations in Stratified Lakes, W72-01864	5C	Effects of Temporary and Permanent Blankets on Tides and Currents in East River, Hydraulic Model Investigation, W72-01827	8A
BARTSCH, ALFRED F.					
A Heavy Mortality of Fishes Resulting from the Decomposition of Algae in the Yahara River, Wisconsin, W72-01797	5C	BENNETT, J. H.		BOGAN, RICHARD H.	
Stream Life and the Pollution Environment, W72-01803	5C	Iodine and Algae in Sedimentary Rocks Associated with Iodine-Rich Brines, W72-02073	2K	Theoretical Evaluation of Filter Modeling Experiments, W72-01859	5E
BASCO, D. R.					
Drag Forces on Baffle Blocks in Hydraulic Jumps, W72-02019	8B	BENNETT, O. L.		BOGUSZEWSKI, WACLAW	
		Effect of Two Growth-Regulating Chemicals on Yield and Water Use of Three Perennial Grasses, W72-01908	3F	Effects of Mineral Fertilization in 4 Course Rotation on Sandy Soil: II. Results of Investigations in 4th Course of Rotation in an Experiment of Many Yrs in the Experiment Stn. Malyszyn Wieki, (In Polish), W72-01944	3F
BASU, A. K.					
Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notamment Des Fabricues de Pate a Papier et d'Huile Vegetale Hydrogenee), W72-02208	5B	BERGSTROM, K. L.		BOIKO, N. P.	
		Enhancement of Ecologic and Aesthetic Values of Water Associated with Interstate Highways, W72-01698	4C	Peculiarities of Protective Afforestation on the 'Bogara' (Unirrigated Lands) of Uzbekistan, (In Russian), W72-01902	4A
BATANOUNY, KAMAL HASSAN					
Contribution to the Autecology of Urginea Maritima in Egypt, W72-01923	2I	BESCH, WULF		BOLTER, ERNST	
		The Distribution of Species of the Genus <i>Rivulogammarus</i> in Flows of Northern Baden and Southern Wuerttemberg, W72-01952	2I	Water Geochemistry of Mining and Milling Retention in the 'New Lead Belt' of Southeast Missouri, W72-01692	5B
BATANOVNY, KAMAL					
Autecology of Common Egyptian Fagonia Species, W72-01922	2I	BEYROM, S. G.		BOND, J. J.	
		Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektivny ispol'zovaniya podzemnykh vod yugovostochnoy chasti Zapadnoy Sibiri), W72-02102	4B	Soil Water Extraction by N-Fertilized Spring Wheat, W72-02165	3F
BATANOVNY, MOHIEY					
Autecology of Common Egyptian Fagonia Species, W72-01922	2I	BHATNAGAR, P. S.		BOPP, C. D.	
		Performance of Mexican Dwarf Wheats, W72-02174	3F	Stabilization of Product Water From Seawater Distillation Plants, W72-01835	3A
BAUER, A.					
Influence of Atmospheric and Soil Environmental Parameters on the Diurnal Fluctuations of Leaf Water Status of Barley, W72-01970	3F	BHUIYAN, S. I.		BORN, J. J.	
		Dynamic Simulation of Vertical Infiltration into Unsaturated Soils, W72-01782	2G	Determining the Demand and Economic Value for the Water-Based Outdoor Recreation Resources at Lake MacBride State Park in the Summer of 1970, W72-01980	6D
BAUMGARTNER, D. J.					
The Barged Ocean Disposal of Wastes: A Review of Current Practice and Methods of Evaluation, W72-01987	5C	BISHOP, H.		BOSCH, O. J. H.	
		In-Situ Regenerable Membranes for Reverse Osmosis, W72-01837	3A	The Influence of Bush Veld Trees on the Productivity of <i>Panicum-Maximum-M</i> : A Preliminary Report, W72-02239	3F
BAYLIS, I. A. E.					
Further Studies on Some Saline Lakes of Southeast Australia, W72-02191	2H	BIXLER, H. J.		BOSE, R. N.	
		Final Report on Control of Concentration Polarization in Reverse Osmosis Desalination of Water, W72-02107	3A	Refraction Seismic Investigation at Zemu Glacier, Sikkim, W72-02000	2C
BEAMER, J. H.					
The Simulation and Optimization of a Single Effect Multi-Stage Flash Desalination Plant, W72-02131	6A	Membranes for Desalination by Reverse Osmosis, W72-02046	3A	BOSWELL, A. M.	
				Industrial Wastes as a Source of Tastes and Odors in Water Supplies, W72-01815	5C
BECK, KEVIN C.					
Diurnal Variations in the Chemical Characteristics of the Ogeechee Estuary in Georgia,		BLANCHAR, R. W.		BOULTON, N. S.	
		Effects of Recent and Past Phosphate Fertilization on the Amount of Phosphorus Percolating Through Soil Profiles into Subsurface Waters, W72-01691	2G	An Extended Theory of Delayed Yield from Storage Applied to Pumping Tests in Unconfined Anisotropic Aquifers, W72-02011	4B
BLISS, L. C.					
A Hydrostatic Lysimeter to Measure Evapotranspiration Under Remote Field Conditions,		BOUWER, H.		BOUWER, H.	
				Renovating Sewage Effluent by Ground-Water Recharge,	

AUTHOR INDEX

CHEKOI, V. N.

W72-02226	5D	W72-01767	3F	W72-01915	2H
BOWEN, V. T. Plutonium-239 in and Over the Atlantic Ocean, W72-02083	5B	BRUNNER, DIRK R. Virus Inactivation During Phosphate Precipitation, W72-01852	5D	CANNON, G. A. A Biaxial Propeller Current-Meter System for Fixed-Mount Applications, W72-02038	7B
BOYER, D. G. The Use of a Realistic Rainfall Simulator to Determine Relative Infiltration Rates of Contributing Watersheds to the Lower Gila Below Painted Rock Dam, W72-02220	2G	BRUSVEN, M. A. Drift Periodicity and Upstream Dispersion of Stream Insects, W72-02248	2I	CAPSTICKDALE, L. South Africa and Its Water Problem (L'Afrique du Sud et le Probleme de L'eau), W72-02209	4A
BOYER, J. S. Rapid Field Measurement of Leaf Water Potential in Soybean, W72-02177	3F	BUIE, B. F. Uranium and Tritium as Natural Tracers in the Floridian Aquifer, W72-01696	4B	CARDENAS, RUBEN Water and Air Changes in Grapefruit, Corn, and Cotton Leaves with Maturation, W72-01772	3F
BOYLE, W. C. Oxygen Diffusion Through a Pure Culture Floc of <i>Zooigloea Ramigera</i> , W72-01851	5D	BUKOV, A. X. Interrelations Between Tree Species in Forest Belts on Unirrigated Lands (In Russian), W72-01900	4A	CAROLUS, R. L. Evaporative Cooling Techniques for Regulating Plant Water Stress, W72-02242	2D
BRANDSTETTER, A. Determination of Nonlinear Functional Response Functions in Rainfall-Runoff Processes, W72-02116	2A	BULKLEY, J. W. Validation of Political Simulation Models - Water Resource Projects, W72-02129	6A	CARPENTER, W. L. Measurement, Control and Changes in Foaming Characteristics of Pulping Wastes During Biological Treatment, W72-01877	5D
BREED, C. S. Physiographic Limitations upon the Use of Southwestern Rivers, W72-02235	6B	BULLER, A. T. Channel Stability in the Estuary: Controls by Bedrock and Unconsolidated Post-Glacial Sediment, W72-01721	2L	CARR, R. A. Some Aspects of the Geochemistry of F, Fe and Mn in Coastal Waters and in Fresh-Water Springs on the Southeast Coast of Hawaii, W72-01998	2K
BREZONIK, PATRICK L. Application of Mathematical Models to the Eutrophication Process, W72-01991	5B	BURAKOV, D. A. Formation of Spring Runoff in the Vasyugan'-ye (O formirovani vesennego stoka v usloviyah Vasyugan'-ya), W72-02068	4A	CARTER, BUFORD J. JR Model for Flow Augmentation Analysis-An Overview, W72-01874	5G
BRIAN, P. L. THIBAUT Continuous Washing of Brine from Ice, W72-01832	3A	BURBANK, N. C. JR A Study of Pineapple Cannery Waste, W72-01876	5D	CARTER, O. G. A Comparative Study of Two Methods of Applying CCC (2-Chloroethyl) Trimethylammonium Chloride to Wheat, W72-02118	3F
BRINLEY, FLOYD J. Sewage, Algae and Fish, W72-01788	5C	BURKARDT, L. A. Complexes of Silver Iodide and Secondary Amines, W72-02072	3B	CARTWRIGHT, K. Redistribution of Geothermal Heat by a Shallow Aquifer, W72-01720	2F
BROEKHUYSEN, G. J. The Ecology of South African Estuaries: X. St. Lucia: A Second Report, W72-02204	2L	BURNHAM, C. W. Thermodynamic Properties of Water to 1,000C and 10,000 Bars, W72-02048	1A	CHAMBERS, H. W. Sheet Erosion on Forest Soils, W72-02249	2J
BROWN, D. MURRAY Estimating Corn Canopy Extreme Temperatures From Shelter Values, W72-01969	3F	BURNS, O. B. JR Pilot Mechanical Aeration Studies of the Jackson River in Covington, West Virginia, W72-01845	5G	CHANDRASEKARAN, D. Shapes of Grit Chambers to Achieve Certain Velocity-Head Relations with given Shapes of Outlet Weirs, W72-01729	8B
BROWN, K. W. Energy and CO ₂ Balance of an Irrigated Sugar Beet (<i>Beta Vulgaris</i>) Field in the Great Plains, W72-02178	3F	BURNS, R. H. Radioactive Wastes-Their Treatment and Disposal, W72-01871	5D	CHANAY, W. R. Water Transport in Relation to Expansion and Contraction of Leaves and Fruits of 'Calamondin' Orange, W72-01892	2D
BROWN, RAY W. Distribution of Plant Communities in Southeastern Montana Badlands, W72-01930	2I	BYRAM, K. V. The Barged Ocean Disposal of Wastes: A Review of Current Practice and Methods of Evaluation, W72-01987	5C	CHANG, JEN-HU A Critique of the Concept of Growing Season, W72-02211	3F
BRUCE, R. C. Fertility Studies of Pasture Soils in the Wet Tropical Coast of Queensland: I. Soil-Vegetation Classification Units, W72-01737	3F	CAMPBELL, G. S. Psychrometric Determination of Water Potential of Desert Plants, W72-01761	2I	CHARLESON, A. W. A Method of In Situ Stiffness Measure, W72-01770	8D
Fertility Studies of Pasture Soils in the Wet Tropical Coast of Queensland: II. Granitic Soils, W72-01737		CAMPBELL, R. N. The Growth of Brown Trout <i>Salmo Trutta</i> L. in Northern Scottish Lochs with Special Reference to the Improvement of Fisheries,		CHEKOI, V. N. Dynamics of Changes in Chemical Composition of Green Algae of the Black Sea, (In Russian),	

AUTHOR INDEX

CHEMIN, A. N.

W72-01920 2L

CHEMIN, A. N.
Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov basseyna r. Obi),
W72-02062 4A

CHENG, CHEN-YEN
Constant Total Pressure Evaporation Process with Heat Reuse by a Built-in Engine,
W72-01834 3A

CHESTERS, G.
Design and Construction of a Shallow Water Sediment Core Sampler,
W72-01738 5A

CHIANG, L. T.
Sorption and Desorption of Chlorinated Hydrocarbon Pesticides in Aquatic Sediment Minerals,
W72-01779 5B

CHIEN, F. S.
Sorption and Desorption of Chlorinated Hydrocarbon Pesticides in Aquatic Sediment Minerals,
W72-01779 5B

CHITTENDEN, M. E.
Oxygen Requirements of Some Marine and Anadromous Fishes, with Particular Reference to Problems of Measurement,
W72-01875 5C

CHRISTIAN, SHERRILL D.
Solute Properties of Water—Part II,
W72-02110 1A

CHUNG, Y.
Pacific Bottom Water: Penetration East Around Hawaii,
W72-02040 2E

CIRIACY-WANTRUP, S. V.
Concepts Used as Economic Criteria for a System of Water Rights,
W72-02148 6E

CLAIMOS, D. M.
Conditional Streamflow Probability Distributions,
W72-02223 6A

CLAPPERTON, C. M.
Evidence of Cirque Glaciation in the Falkland Islands,
W72-01713 2J

CLARK, B. D.
The Barged Ocean Disposal of Wastes: A Review of Current Practice and Methods of Evaluation,
W72-01987 5C

CLARK, D. J.
Seiche Motions for a Basin of Rectangular Plan and of Nonuniform Depth,
W72-02031 2E

CLARKE, R. T.
Objectives and Methods of Data Processing and Analysis in the Water Treatment Context,
W72-02128 6A

CLUFF, C. B.
The Use of a Realistic Rainfall Simulator to Determine Relative Infiltration Rates of Contributing Watersheds to the Lower Gila Below Painted Rock Dam,

W72-02220 2G

CLYDE, C. G.
Optimization in Municipal Water Supply System Design,
W72-02125 6A

COLER, R. A.
The Response of a Specialized Aquatic Ecosystem, The Duckweed Rhizosphere, to Selected Environmental Influences,
W72-02114 5C

COLLINS, A. G.
Iodine and Algae in Sedimentary Rocks Associated with Iodine-Rich Brines,
W72-02073 2K

COLONELL, J. M.
Control of Benthic Deposits in Lakes,
W72-01699 2H

Hydrologic Factors in the Determination of Watershed Yields,
W72-01700 2A

COLVILLE, W. L.
Residual Mineral N Accumulation in Soil and its Utilization by Irrigated Corn (*Zea Mays* L.),
W72-02167 3F

CONATSER, W. E.
Grand Isle: A Barrier Island in the Gulf of Mexico,
W72-01718 2J

CONWAY, J. B.
A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use,
W72-01735 5C

COOKE, WILLIAM B.
Potential Plant Pathogenic Fungi in Sewage and Polluted Water,
W72-01809 5C

Trickling Filter Ecology,
W72-01819 5D

COOPER, WILLIAM E.
An Experimental Approach to the Production Dynamics and Structure of Freshwater Animal Communities,
W72-02192 2I

CORLISS, J. B.
The Origin of Metal-Bearing Submarine Hydrothermal Solutions,
W72-02044 2K

COURTIN, G. M.
A Hydrostatic Lysimeter to Measure Evapotranspiration Under Remote Field Conditions,
W72-02187 2D

CRAIG, J. R.
Saline Waters: Genesis and Relationship to Sediments and Host Rocks,
W72-01755 2K

CRAM, S. P.
The Radiochromatographic Analysis of Fresh Water Resources,
W72-01981 2K

CROSS, R. A.
Final Report on Control of Concentration Polarization in Reverse Osmosis Desalination of Water,

W72-02107 3A

Membranes for Desalination by Reverse Osmosis,
W72-02046 3A

CUMMINS, K. W.
Predicting Variations in Energy Flow Through a Semi-Controlled Lotic Ecosystem,
W72-01701 2I

DACOSTA, PEDRO C. C.
Effect of Urbanization on Storm Water Peak Flows,
W72-01857 4C

DAGG, M.
The Effect of Different Cultivation Techniques on Soil Moisture Conservation and the Establishment and Yield of Maize at Kongwa, Central Tanzania,
W72-01967 3F

DAHLBERG, MICHAEL D.
The Freshwater Fishes of Georgia,
W72-01955 2I

DALEY, J. C.
Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements,
W72-02014 7B

DANIEL, T. C.
Design and Construction of a Shallow Water Sediment Core Sampler,
W72-01738 5A

DAS GUPTA, D. K.
Studies in Water Relations of Rice: V. Effect of Varying Water Regimes on the Growth of Main Shoot in Indica Rice,
W72-02170 3F

DAS, N. C.
Interculture in Transplanted Rice (*Oryza Sativa* L.),
W72-02171 3F

DAUBERT, HENRY
Improving Municipal Water Supplies in Colorado by Desalting,
W72-01839 3A

DAUMANN, ERICH
On the Question of the Pollination by Rain (Ombragamy),
W72-02184 2I

DAVIES, RONALD W.
The Incidence and Intensity of Predation on Lake-dwelling Trichads in the Field,
W72-01948 2H

DAVIS, J. J.
Bioaccumulation of Radioisotopes Through Aquatic Food Chains,
W72-01792 5B

DAVIS, N. F.
Thermodynamic Properties of Water to 1,000C and 10,000 Bars,
W72-02048 1A

DAVIS, THOMAS A.
Field Evaluation of Forced-Flow Electrodesalination,

AUTHOR INDEX

EICHENLAUB, V. L.

W72-01836	3A	W72-01973	3F	W72-01920	2L
DAWSON, R. The Effect of Different Cultivation Techniques on Soil Moisture Conservation and the Establishment and Yield of Maize at Kongwa, Central Tanzania, W72-01967	3F	DINESH, RAGHUBIR SINGH Quality of Irrigation Waters of Kanjhwala and Alipur Blocks of Delhi in Relation to Soil Properties and Growth of Wheat, W72-01964	3C	DUDLEY, N. J. Irrigation Planning 2: Choosing Optimal Acreages Within a Season, W72-02130	6A
DEB, ARUN K. Numerical Solution of Filtration Equations, W72-01841	5D	DIPESO, C. C. Use and Abuse of Southwestern Rivers. The Pueblo Dweller, W72-02236	3F	DUKE OF EDINBURGH, PHILIP Wildlife Crisis, W72-01911	2I
DEBANO, L. F. Some Geographic Implications of Water-Repellent Soils, W72-01745	2G	DOLAR, S. G. A Self-Watering System for Growing Plants in Potted Soils, W72-02166	3F	DUMOND, DAVID M. Floristic and Vegetational Survey of the Chattooga River Gorge, W72-01932	2I
DELANEY, G. A. Relationship Between Escherichia Coli, Type I and Enterococci in Water, W72-01854	5B	DOMMEL, P. R. Enhancement of Ecologic and Aesthetic Values of Water Associated with Interstate Highways, W72-01698	4C	DUPNICK, E. Collective Utility: A Systems Approach for the Utilization of Water Resources, W72-02232	4B
DELOACH, R. E. Oxygen Sag and Stream Self-Purification, W72-01785	5C	DORAISWAMY, P. C. Energy Balance and Spectral Properties of a Reflectorized Soybean Canopy, W72-01747	3F	DURRANT, M. J. Effects of Nitrogen Fertilizer, Plant Population and Irrigation on Sugar Beet: III. Water Consumption, W72-01959	3F
DENNER, W. Temperature and Conductivity Measurements Under Ice Island T-3, W72-02042	2K	DOUDOROFF, PETER Biological Indices of Water Pollution with Special Reference to Fish Population, W72-01791	5C	DUTTA, N. P. Effects of Nitrogen Fertilizer, Plant Production and Irrigation on Sugar Beet: II. Nutrient Concentration and Uptake, W72-01960	3F
DENNIS, R. E. Sugar Beets in Arizona, W72-01742	3F	DOWNEY, LLOYD A. Water Use by Maize at Three Plant Densities, W72-01968	3F	DVORACEK, M. J. Optimal Utilization of Playa Lake Water in Irrigation, W72-02231	3F
DENNY, J. L. Statistical Inference on Streamflow Processes with Markovian Characteristics, W72-01704	2E	DRACOS, T. Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation, W72-01727	2J	DRAYCOTT, A. P. Effects of Nitrogen Fertilizer, Plant Population and Irrigation on Sugar Beet: I. Yields, W72-01961	3F
DERRINGTON, CLARA F. Survey of Applications of Epoxy Resins for Civil Works Projects, W72-02120	8G	DYNES, RUSSELL R. Environment Crises, W72-01694	6B	EDDY, SAMUEL The Plankton of the Sangamon River in the Summer of 1929, W72-01795	5C
DESHPANDE, P. B. Dynamic Fluid Loss During Viscous Flow Through a Porous Vertical Slot, W72-02060	8B	EDGERTON, A. T. Microwave Radiometric Detection of Oil Slicks, W72-02024	5A	EDMOND, J. M. Pacific Bottom Water: Penetration East Around Hawaii, W72-02040	2E
DEVRIES, R. N. Optimization in Municipal Water Supply System Design, W72-02125	6A	EDLERS, E. The Chalus Valley and its Terraces: Studies in the History and Regionalization of the Central Elbur (North Iran) (Das Chalus-Tal und Seine Terrassen, Studien Zur Landschaftsgliederung und Landschaftsgeschichte des Mitleren Elburs, (Nordiran), W72-02207	4A	EICHENLAUB, V. L. Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States,	
DICKASON, D. G. Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States, W72-02210	2B	DREIER, A. F. Residual Mineral N Accumulation in Soil and its Utilization by Irrigated Corn (<i>Zea Mays L.</i>), W72-02167	3F		
DICKERSON, W. H. Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia, W72-02025	2B	DUCKSTEIN, L. Collective Utility: A Systems Approach for the Utilization of Water Resources, W72-02232	4B		
DIGIANO, F. A. Control of Benthic Deposits in Lakes, W72-01699	2H	DUDKIN, M. S. Comparison of Water Pricing Structures from a Collective Utility Viewpoint, W72-02233	6C		
DIGREGORIO, D. Advance Wastewater Treatment, W72-01879	5D	DUDKIN, M. S. A Stochastic Analysis of Flows on Rillito Creek, W72-02224	2E		
DIMITROV, S. Density of Irrigated Fodder Maize Grown as First Crop (In Bulgarian),		DUDKIN, M. S. Dynamics of Changes in Chemical Composition of Green Algae of the Black Sea, (In Russian),			

AUTHOR INDEX

EL-AZAB, E. M.

EL-AZAB, E. M.	W72-02210	2B	W72-02234	7B	W72-02036	5B
EL-AZAB, E. M.	Effect of Some Soil Properties on Root and Tissue Growth and Mineral Content of 'Washington' Naval Orange and 'Balady' Mandarin, W72-01891	2I	FERNET, L.	Relation Between Beginning of Emergence of Odonates, Development of Leaves in Spring, and Water Temperature Studies: Reading, UK, July 23-30, 1966, W72-02246	2I	FOSBERG, MICHAEL A.
ELLIOTT, J. M.	Upstream Movements of Benthic Invertebrates in a Lake District Stream, W72-01936	2H	FESKO, K. YA.	Effect of Water Losses from Irrigation Canals on Groundwaters of the Aleysk Irrigation System (Vliyanie poter' vody iz orositel'nykh kanalov na gruntovyye vody Aleyskov orositel'noy sistemy), W72-02103	3F	FOSTER, D. H.
ELLIS, M. M.	Detection and Measurement of Stream Pollution, W72-01804	5C	FFOLLIOTT, P. F.	Hydrologic Characterization of Forested Watersheds in Arizona, W72-01702	2C	FOSTER, R. F.
EMMONS, R. E.	Low Cost Storm Drainage With Paved Channels, W72-01880	4A	FILARETOV, I.	Progress in Developing Forest Management Guidelines for Increasing Snowpack Water Yields, W72-02230	4A	FOX, L. K.
ESLER, A. E.	Manawatu Sand Dune Vegetation, W72-01928	2I	FINNEGAN, W. G.	Comparative Study of Italian Polyploid Varieties of Beets Used in Fodder, Cultivated without Irrigation (In Bulgarian), W72-01974	3F	FRANCIS, C. M.
EUBANKS, JAMES O.	Effects of Light Intensity and Osmotic Stress on the Water Relations of <i>Populus tremuloides</i> , W72-01909	2I	FIREMAN, B.	Use and Abuse of Southwestern Rivers. Historic Man-The Anglo, W72-02238	4A	FRANKLIN, M. J.
EVANS, D. C.	Time in Transit of Water Moving Vertically for Ground Water Recharge, W72-01750	2G	FISHER, D. A.	The Possible Future Behaviour of Berendon Glacier, Canada - A Further Study, W72-01709	2C	FREDRICH, A. J.
EVANS, D. D.	Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals, W72-01781	2F	FISHER, JAMES	Wildlife Crisis, W72-01911	2I	FRITTS, H. C.
EWING, J.	Aleutian Plain Sediments and Lithospheric Plate Motions, W72-02043	2J	FLOWERDAY, A. F.	Residual Mineral N Accumulation in Soil and its Utilization by Irrigated Corn (<i>Zea mays</i> L.), W72-02167	3F	FROST, S.
EYNON, D.	Wastewater Treatment and Re-Use of Treated Sewage as an Industrial Water Supply, W72-01860	5D	FOGED, NIELS	The Ecosystem of the Arctic Lake Nordlaguna, Jan Mayen Island: II. Plankton and Benthos, W72-02190	2H	FUKUSHIMA, KIKUO
FAHEY, B. D.	Permafrost Occurrence in the Front Range, Colorado Rocky Mountains, U.S.A., W72-01712	2C	FOGGIN, G. T.	Some Geographic Implications of Water-Repellent Soils, W72-01745	2G	GAIGHER, I. G.
FAUST, W. F.	Blue-Green Algal Effects on Some Hydrologic Processes at the Soil Surface, W72-02218	2G	FORBES, STEPHEN A.	The Lake as a Microcosm, W72-01787	5C	GARDNER, MICHAEL L. G.
FEDERER, B.	On the Temperature Profile and the Age Profile in the Central Part of Cold Ice Sheets, W72-01705	2C	FORDHAM, J. W.	Multi-Site Streamflow Simulation of Truckee River, Nevada, W72-01778	2E	GARDNER, W. H.
FEDOSEYEV, A. P.	Inertial Forecast of Water Storage in Soil and its Economic Effectiveness (Inertsionnyy prognoz pochvennykh vlagozapasov i yego ekonomicheskaya effektivnost'), W72-02095	2G	FORRESTER, W. D.	Distribution of Suspended Oil Particles Following the Grounding of the Tanker Arrow,		GLE, R. C.
FENG, T. H.	Control of Benthic Deposits in Lakes, W72-01699	2H				GARGAS, EIVIND
FERGUSON, C. W.	Tree-Ring Dating of Colorado River Driftwood in the Grand Canyon,					Measurements of Primary Production Dark Fixation and Vertical Distribution of the Microbenthic Algae in the Oresund,

AUTHOR INDEX

HAMMOND, L. C.

W72-02205	2L	W72-02094	2L	W72-01858	7C
GATES, J. S. Uncertainties in Digital-Computer Modeling of Groundwater Basins, W72-02215	2F	GODSHALL, F. A. Chemical Integrating Thermometer for Water Temperature Measurement, W72-02013	2K	GREYSON, J. The Influence of Model Membrane Systems on the Structure of Water, W72-02109	3A
GAUDY, A. F. JR Mechanism and Kinetics of Substrate Utilization at High Biological Solids Concentrations, W72-01843	5D	GOLDBERG, D. Changes in the Ratio Between Sugar Beet Evapotranspiration and Pan Evaporation During the Growing Season, W72-02179	3F	GROMOVA, Z. N. CO ₂ and O ₂ Contents in the Soil and Groundwaters of the Territory Around the Rybinsk Reservoir, (In Russian), W72-01733	2G
GAUFIN, ARDEN R. The Effects of Sewage Pollution on the Fish Population of a Midwestern Stream, W72-01805	5C	GOLDMAN, C. R. Is The Canary Dying: The Time Has Come for Man, Miner of the Worlds Resources To Surface, W72-02250	6G	GROSSMAN, RICHARD P. Water-Borne Typhoid Epidemic at Keene, New Hampshire, W72-01810	5C
Some Important Biological Effects of Pollution Often Disregarded in Stream Surveys, W72-01790	5C	GOLDSTEIN, M. E. Analytical Solution for the Wind-Driven Circulation in a Lake Containing an Island, W72-02022	2H	GRUA, C. New Water Through Desalting, W72-01749	3A
GAUSMAN, HAROLD W. Water and Air Changes in Grapefruit, Corn, and Cotton Leaves with Maturation, W72-01772	3F	GOODWIN, C. R. Tidal Choking, W72-01725	2L	GUARINO, CARMEN F. Toward Computer Control of Wastewater Treatment, W72-01824	5D
GEDNEY, R. T. Analytical Solution for the Wind-Driven Circulation in a Lake Containing an Island, W72-02022	2H	GORHAM, EVILLE The Diversity of Pigments in Lake Sediments and Its Ecological Significance, W72-01784	5C	GUNNER, H. B. The Response of a Specialized Aquatic Ecosystem, The Duckweed Rhizosphere, to Selected Environmental Influences, W72-02114	5C
GELLMAN, I. Measurement, Control and Changes in Foaming Characteristics of Pulping Wastes During Biological Treatment, W72-01877	5D	GORNAT, B. Changes in the Ratio Between Sugar Beet Evapotranspiration and Pan Evaporation During the Growing Season, W72-02179	3F	GUPTA, V. L. Multi-Site Streamflow Simulation of Truckee River, Nevada, W72-01778	2E
GEMMELL, ROBERT S. Coagulation of Activated Carbon Suspensions, W72-01862	5E	GOSSE, L. E. Outdoor Recreation in New York State: Projections of Demand, Economic Value, and Pricing Effects for the Period 1970-1985, W72-02134	6B	GYR, A. Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation, W72-01727	2J
GERGOV, G. Determination of the Loop Discharge Rating Curve for Flood Wave Propagation, W72-01724	2E	GRACE, J. L. JR Model Studies of Outfall Systems for Desalination Plants (Part I - Flume Study), W72-01838	5E	GYUK, I. Nonlinear Dupuit Equations for the Phreatic Surface of a Semi-Infinite Aquifer, W72-02004	2F
GHORASHY, S. R. Rapid Field Measurement of Leaf Water Potential in Soybean, W72-02177	3F	GOWAN, D. The Disposal of Agricultural Waste, W72-02142	5E	HALL, DONALD J. An Experimental Approach to the Production Dynamics and Structure of Freshwater Animal Communities, W72-02192	2I
GILL, M. A. Height of Sand Dunes in Open Channel Flows, W72-02021	2J	GRANT, R. S. Floods in Harvard Southwest Quadrangle, Northeastern Illinois, W72-02085	2E	HALLOPEAU, C. Preliminary Research in the Laboratory on Experimental Brackish Ecosystems, W72-02203	5A
GILMAN, HAROLD D. Toward Computer Control of Wastewater Treatment, W72-01824	5D	GRANTHAM, GEORGE R. Model for Flow Augmentation Analysis-An Overview, W72-01874	5G	HALPERN, D. Observations on Short-Period Internal Waves in Massachusetts Bay, W72-02035	2L
GLANZMAN, C. F. Tidal Choking, W72-01725	2L	GREEN, M. B. Insect Populations of Sludge-Drying Beds, W72-01863	5D	HAMER, E. A. G. The Design, Fabrication and Testing of a 1000 Gallon Per Day Tubular Reverse Osmosis Pilot Plant, W72-02045	3A
GLASCOCK, M. G. Determining the Demand and Economic Value for the Water-Based Outdoor Recreation Resources at Lake MacBride State Park in the Summer of 1970, W72-01980	6D	GREENWAY, A. ROGER Investigation of the Effects of Urbanization on Precipitation Type, Frequency, Areal and Temporal Distribution, W72-01982	2B	HAMID, S. A. Effects of Induced Drought on Rice Plants, W72-01963	3F
GLENNE, B. Tidal Choking, W72-01725	2L	GRENNERY, WILLIAM J. Finite-Difference Convection Errors,		HAMMOND, L. C. Movement and Adsorption of Pesticides in Sterilized Soil Columns,	
GLUKHOVSKIY, B. KH. Hydrologic Computational Methods for Marine Hydraulic Engineering Construction (Metody morskikh hidrologicheskikh raschetov dlya tseley gidrotehnicheskogo stroitel'stva),					

AUTHOR INDEX

HAMPTON, E. R.

W72-01697	SB	W72-01810	SC	W72-01827	8A
HAMPTON, E. R.					
Hydrologic Effects of Water Control and Management of Southeastern Florida,	4A	HEANEY, JAMES P.		HILLBRIGHT-ILKOWSKA, ANNA	
W72-02090		Model for Flow Augmentation Analysis-An Overview,	5G	The Effect of Sampling Frequency and the Method of Assessment on the Production Values Obtained for Several Zooplankton Species,	
HANES, N. B.		W72-01874		W72-01933	2I
A Critical Examination of Bathing Water Quality Standards,	5B	HELLMUTH, E. O.			
W72-01997		Ecophysiological Studies on Plants in Arid and Semiarid Regions in Western Australia. IV. Comparison of the Field Physiology of the Host, <i>Acacia Grasbyi</i> and its Hemiparasite, <i>Amyema Nestor</i> Under Optimal and Stress Conditions,	2I		
Relationship Between <i>Escherichia Coli</i> , Type I and <i>Enterococci</i> in Water,	5B	W72-01740			
W72-01854		HENDERSON, CROSSWELL			
HANNA, G. P. JR		Value of the Bottom Sampler in Demonstrating the Effects of Pollution on Fish-Food Organisms and Fish in the Shenandoah River,	5C		
Effect of Sulfate and Other Ions in Coagulation with Aluminum,	5D	W72-01800			
W72-01869		HENDERSON, D. W.			
HANSEN, H. J.		Perennial Irrigated Pastures: I. Plant, Soil Water, and Animal Responses Under Rotational and Continuous Grazing,	3F		
Transmissivity Tracts in the Coastal Plain Aquifer of Maryland,	2F	W72-02180			
W72-01730		HENNIGHAUSEN, F. H.			
Geochemical Interpretations of Groundwater Flow Systems,	2K	Change of Chloride Content of Water in Response to Pumping in the Artesian Aquifer in the Roswell-East Grant Plains Area, Chaves County, New Mexico,	4B		
W72-02007		W72-01751			
HAPPY, CHRISTINE M.		HENRY, E. N.			
The Effects of Stratification on Phyto-Plankton Diatoms in a Small Body of Water,	2I	Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia,	5C		
W72-01919		W72-02025			
Some Physico-chemical Investigations of Stratification in Abbot's Pool, Somerset: The Distribution of some Dissolved Substances,	2H	HERRON, G. M.			
W72-01937		Residual Mineral N Accumulation in Soil and its Utilization by Irrigated Corn (<i>Zea Mays</i> L.),	3F		
HARSHAW, B. B.		W72-02167			
Geochemical Interpretations of Groundwater		HEUKELEKIAN, H.			
Flow Systems,		Effect of Sunlight and Green Organisms on Re-aeration of Streams,	5C		
W72-02007		W72-01794			
HAPPY, CHRISTINE M.		HICKEY, M. E.			
The Effects of Stratification on Phyto-Plankton Diatoms in a Small Body of Water,	2I	Synthetic Rubber Canal Lining, Laboratory and Field Investigations of Synthetic Rubber Sheeting for Canal Lining - Open and Closed Conduit Systems Program,	8G		
W72-01919		W72-01763			
HARSHAW, B. B.		HIGGINS, G. R.			
Geochemical Interpretations of Groundwater		Hydrologic Factors in the Determination of Watershed Yields,	2A		
Flow Systems,		W72-01700			
W72-02007		HILER, E. A.			
HARSHAW, B. B.		Dynamic Simulation of Vertical Infiltration into Unsaturated Soils,	2G		
Geochemical Interpretations of Groundwater		W72-01782			
Flow Systems,		HILL, C. E.			
W72-02007		Limitation on Diversion From the Watershed: Riparian Roadblock to Beneficial Use,	6E		
HARSHAW, B. B.		W72-02149			
Geochemical Interpretations of Groundwater		HILL, J. R.			
Flow Systems,		An Improved Method for Determining Ice Fabrics,	2C		
W72-02007		W72-02002			
HARSHAW, B. B.		HILL, T. C.			
Geochemical Interpretations of Groundwater		Effects of Temporary and Permanent Blankets on Tides and Currents in East River, Hydraulic Model Investigation,			
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
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HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
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HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
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Geochemical Interpretations of Groundwater					
Flow Systems,					
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HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
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HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
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Geochemical Interpretations of Groundwater					
Flow Systems,					
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Geochemical Interpretations of Groundwater					
Flow Systems,					
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Geochemical Interpretations of Groundwater					
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W72-02007					
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Geochemical Interpretations of Groundwater					
Flow Systems,					
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Geochemical Interpretations of Groundwater					
Flow Systems,					
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Geochemical Interpretations of Groundwater					
Flow Systems,					
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Geochemical Interpretations of Groundwater					
Flow Systems,					
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Geochemical Interpretations of Groundwater					
Flow Systems,					
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Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					
HARSHAW, B. B.					
Geochemical Interpretations of Groundwater					
Flow Systems,					
W72-02007					

AUTHOR INDEX

KARNATSEVICH, I. V.

W72-02244	3F	W72-01714	2C	W72-01958	3C
HOWELL, D. T. Irrigation Planning 2: Choosing Optimal Acreages Within a Season, W72-02130	6A	IVES, J. D. Permafrost Occurrence in the Front Range, Colorado Rocky Mountains, U.S.A., W72-01712	2C	JONES, J. G. Studies on Freshwater Bacteria: Effect of Medium Composition and Method on Estimates Bacterial Population, W72-01956	5C
HRISTOV, A. Comparative Evaluation of the Importance of Individual Measures in the Total Agrotechnical Complex of Maize Irrigation (In Bulgarian), W72-01966	3F	JACKSON, R. D. Field Measurements of Soil-Water Content and Soil-Water Pressure, W72-02222	2G	JONES, S. J. The Possible Future Behaviour of Berendon Glacier, Canada - A Further Study, W72-01709	2C
Comparative Study of Native and Introduced Lucerne Varieties Grown for Six Years in Central North Bulgaria, (In Bulgarian), W72-01768	3F	Seasonal Effects on Soil Drying After Irrigation, W72-02217	2D	JUNG, G. A. Effect of Two Growth-Regulating Chemicals on Yield and Water Use of Three Perennial Grasses, W72-01908	3F
HRISTOV, G. Consumptive Use of Water by Cotton in Sprinkler and Surface Irrigation in the Region of the State Irrigation System: Stara Zagora, (In Bulgarian), W72-01977	3F	JACOB, H. A. JR Comparison of Plant Water Quality to Proposed Water Quality Standard, W72-02082	5F	KABLER, PAUL W. Selection and Adaptation of Microorganisms in Waste Treatment, W72-01820	5D
HSIEH, J. Psychrometric Determination of Water Potential of Desert Plants, W72-01761	2I	JAMES, W. R. A Class of Probability Models for Littoral Drift, W72-02121	6A	KALINA, G. P. Characteristics in the Distribution of Proteus Group Bacteria in Sewage of Different Origin, (In Russian), W72-01889	5B
HUANG, J. C. Sorption and Desorption of Chlorinated Hydrocarbon Pesticides in Aquatic Sediment Minerals, W72-01779	5B	JENKINS, E. D. Test of the Stroebel Spring - A Supplementary Study of the Fort Carson Expansion Project, Civil Action No. 8920, Tract No. 202, El Paso County, Colorado, W72-02088	4B	KALININ, G. P. A Statistical Theory of Water Level Fluctuations in Undrained Bodies of Water (O statisticheskoy teorii kolebanii urovney vod v besstochnykh vodoyemakh), W72-02097	2H
HULL, J. L. Perennial Irrigated Pastures: I. Plant, Soil Water, and Animal Responses Under Rotational and Continuous Grazing, W72-02180	3F	JENSEN, M. H. Use of Controlled Environment for Vegetable Production in Desert Regions of the World, W72-02243	3F	KALTER, R. J. Outdoor Recreation in New York State: Projections of Demand, Economic Value, and Pricing Effects for the Period 1970-1985, W72-02134	6B
HUNI, A. Evaluation of a Kicking Technique for Sampling Stream Bottom Fauna, W72-02194	2I	JENSEN, R. E. Influence of Atmospheric and Soil Environmental Parameters on the Diurnal Fluctuations of Leaf Water Status of Barley, W72-01970	3F	KANEKO, TATSUHIKO Arthrobacter Luteus Nov. Sp. Isolated From Brewery Sewage, W72-02182	5A
HURD, E. A. Can We Breed for Drought Resistance, W72-01757	3F	JENSEN, T. E. Permafrost-Hydrogeologic Regimen in Two Ice-Free Valleys, Antarctica, from Electrical Depth Sounding, W72-02030	2C	KANEV, S. Density of Irrigated Fodder Maize Grown as First Crop (In Bulgarian), W72-01973	3F
HUSSAIN, M. A. Effects of Induced Drought on Rice Plants, W72-01963	3F	JEWELL, WILLIAM J. Aerobic Decomposition of Algae, W72-01881	5D	KAO, C. W. Effects of Recent and Past Phosphate Fertilization on the Amount of Phosphorus Percolating Through Soil Profiles into Subsurface Waters, W72-01691	2G
HYDE, H. C. Control of Benthic Deposits in Lakes, W72-01699	2H	JOHNSON, J. D. Nitrogen Balance For a 23 Square Mile Minnesota Watershed, W72-02216	2K	KAO, T. -Y. Hydraulic Jump Assisted by Cross-Jet, W72-02020	8B
IGBOZURIKE, M. U. Against Monoculture, W72-01762	3F	JOHNSTON, W. V. The Influence of Model Membrane Systems on the Structure of Water, W72-02109	3A	KAPSE, Y. S. Yield of Cotton in Relation to Rainfall in Madhya Pradesh, W72-02161	3F
INGRAM, WILLIAM M. Stream Life and the Pollution Environment, W72-01803	5C	JONES, BERNARD R. Temperature Requirements for Growth and Survival of Larval Ciscos (Coregonus Arted II), W72-01989	5C	KARAKI, S. Evaluation of Effect of Impoundment on Water Quality in Cheney Reservoir, W72-01773	5F
Suggested Classification of Algae and Protozoa in Sanitary Science, W72-01798	5C	JONES, E. J. W. Aleutian Plain Sediments and Lithospheric Plate Motions, W72-02043	2J	KARGER, BARRY L. Colloid Flotation and Adsorbing Colloid Flotation, W72-02105	5D
IRELAN, B. Salinity of Surface Water in the Lower Colorado River - Salton Sea Area, W72-02074	2K	JONES, G. B. Modification of Carcase Characteristics in Sheep Maintained on a Saline Water Regime,		KARNATSEVICH, I. V. Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestest-	
ITAGAKI, K. A Hot-Wire Engine to Produce Periodic Grooves on an Ice Surface,					

AUTHOR INDEX

KARNATSEVICH, I. V.

vennyye usloviya uvlazhneniya territorii Obskogo basseyna i perspektivu gidromelioratsiyi),				
W72-02063	4A			
KAROJHI, KOHEI				
Observations on the Summer Population of Phytoplankton in Matoya Bay, Shima Peninsula, 1953 and 1954 (In Japanese),				
W72-02200	2L			
KASHEF, A.-A. I.				
Overpumped Artesian Wells Among a Well Group,				
W72-02005	4B			
KATZ, MAX				
The Effects of Sewage Pollution on the Fish Population of a Midwestern Stream,				
W72-01805	5C			
KAWAHARA, F. K.				
Characterization and Identification of Spilled Residual Fuel Oils by Gas Chromatography and Infrared Spectrophotometry,				
W72-02196	5A			
KAWAMURA, TERUYOSHI				
Amount of Pigments and Daily Production of Phytoplankton Occurring in Acidic Lake Toya (In Japanese),				
W72-02197	5C			
Observations on the Summer Population of Phytoplankton in Matoya Bay, Shima Peninsula, 1953 and 1954 (In Japanese),				
W72-02200	2L			
KEENEY, D. R.				
A Self-Watering System for Growing Plants in Potted Soils,				
W72-02166	3F			
KEMP, M. K.				
Concentration Gradients in Aquifers,				
W72-02055	2F			
KENNEDY, J. F.				
Two Investigations of River Ice: Part I and Part 2,				
W72-02056	2C			
KERR, J. A.				
Multireservoir Analysis Techniques in Water Quantity Studies,				
W72-02057	4A			
KERSHAW, W. E.				
Evaluation of a Kicking Technique for Sampling Stream Bottom Fauna,				
W72-02194	2I			
KHALIFA, TAHA				
Contribution to the Autecology of <i>Urginea Maritima</i> in Egypt,				
W72-01923	2I			
KHAN, M. A. A.				
Effects of Induced Drought on Rice Plants,				
W72-01963	3F			
KHARCHENKO, S. I.				
Investigations of Moisture Exchange in the Zone of Aeration in Irrigated Land (Issledovaniya vlagoodbemena v zone aeratsii na oroshayemykh zemlyakh),				
W72-02070	4A			
KHRICHENKO, E. M.				
Nonirrigated Cultivation of Persian Walnut Under the Conditions of Kislovodsk (In Russian),				
KIMBALL, B. A.				
Seasonal Effects on Soil Drying After Irrigation,				
W72-02217	2D			
KISELITE, T. S.				
The Mineralization Activity of Bacterioplankton in Freshwater Ecosystems, (In Russian),				
W72-01940	2I			
KISIEL, C. C.				
Statistical Inference on Streamflow Processes with Markovian Characteristics,				
W72-01704	2E			
Uncertainties in Digital-Computer Modeling of Groundwater Basins,				
W72-02215	2F			
KISIEL, D. C.				
A Stochastic Analysis of Flows on Rillito Creek,				
W72-02224	2E			
KITAMURA, KUNPEI				
<i>Arthrobacter Luteus</i> Nov. Sp. Isolated From Brewery Sewage,				
W72-02182	5A			
KLEIN, H.				
Hydrologic Effects of Water Control and Management of Southeastern Florida,				
W72-02090	4A			
KLEINIG, C. R.				
Response by Irrigated Grain Sorghum to Broadcast Gypsum and Phosphorous on Heavy Clay Soil,				
W72-02117	3F			
KLEMETSEN, ANDERS				
Plankton Swarms in Lake Gjokvatn, East Finnmark,				
W72-02193	2H			
KNOTT, J. E.				
Tropical Production of Vegetable Crops,				
W72-02241	3F			
KNOX, CAMERON,				
A Permanent record of Plankton Samples Using Holography,				
W72-02202	2I			
KOBAYASHI, MIEKO				
Studies on the Aquatic Insect Community of Mountain Stream at the Foot of Mt. Daisen: I. Ecological Investigation on a Population of Ephemeroptera (In Japanese),				
W72-01953	2I			
KOCH, CARL M.				
Toward Computer Control of Wastewater Treatment,				
W72-01824	5D			
KOH, R. C. Y.				
Transient Motions induced by Local Disturbances in a Linearly Density-Stratified Fluid,				
W72-01726	2E			
KOLKWITZ, R.				
Ecology of Animal Saprobia,				
W72-01799	5C			
Ecology of Plant Saprobia,				
KORELYAKOVA, V. L.				
Chemical Composition of Higher Water Vegetation of the Kiev Reservoir (In Russian),				
W72-01929	2K			
KOSTOURSKI, N.				
Influence of Preceding Crops on the Development and Harvest of Corn and Sugar Beets Cultivated Under Conditions of Irrigation (In Bulgarian),				
W72-01971	3F			
KOSTOV, K.				
Density of Irrigated Fodder Maize Grown as First Crop (In Bulgarian),				
W72-01973	3F			
KOSTUCH, RYSZARD				
Effect of Different Degrees of Soil Moisture Upon Growth Yields and Floristic Changes of the Common Matgrass (<i>Nardus Stricta</i> L.) Community (In Polish),				
W72-01972	2G			
KOZLOWSKI, T. T.				
Water Transport in Relation to Expansion and Contraction of Leaves and Fruits of 'Calamondin' Orange,				
W72-01892	2D			
KRISHNAN, P.				
Mechanism and Kinetics of Substrate Utilization at High Biological Solids Concentrations,				
W72-01843	5D			
KUFFERATH, JEAN				
Contributions to the Study of Bacteria in the Marine Water Off the Belgian Coast,				
W72-01908	5B			
KUMAGAI, J. S.				
A Study of Pineapple Cannery Waste,				
W72-01876	5D			
KUPFERMAN, S. L.				
Cesium-137 in the North Atlantic Measured by Selective Absorption <i>in Situ</i> ,				
W72-02084	5B			
KUPRIYANOV, V. V.				
Surface-Water Resources of the Ob River and Ob-Irtysh Interfluve (Resursy poverkhnostnykh vod r. Ob i Ob'-Irtyshskogo mezhdurech'ya),				
W72-02065	4A			
KUREK, STANISLAW				
Analysis of Snowmelt Phenomena in 1963 and 1964 in Catchment Areas of Three Mountain Streams (In Polish),				
W72-02188	2C			
KUREK, ZOFIA				
Analysis of Snowmelt Phenomena in 1963 and 1964 in Catchment Areas of Three Mountain Streams (In Polish),				
W72-02188	2C			
KWON, KYUNG CHANG				
Constant Total Pressure Evaporation Process with Heat Reuse by a Built-in Engine,				
W72-01834	3A			
LACAZE, J. C.				
Preliminary Research in the Laboratory on Experimental Brackish Ecosystems,				
W72-02203	5A			
LACEY, ROBERT E.				
Field Evaluation of Forced-Flow Electrodesalination,				

AUTHOR INDEX

MACDONALD, F. W.

W72-01836	3A	W72-01758	3F	W72-01978	2A
LACKEY, ELSIE W.		LAUGHLIN, J. K.		LIPPER, R. I.	
A Partial Checklist of Florida Fresh-Water Algae and Protozoa with Reference to McCloud and Cue Lakes, W72-01993	5A	Large Reverse Osmosis System Technology and Module Development, W72-02047	3A	Biological Treatment of Beef Animal Wastes, W72-01777	5D
LACKEY, JAMES B.		LAURENT, E. A.		LISHENKO, A. A.	
Aquatic Biology and the Water Works Engineer, W72-01813	5C	Empirical Study of Economic-Ecologic Linkages in a Coastal Area, W72-02126	6A	Characters of Formation of Forest Shelterbelts of Various Composition and Methods of Their Establishment (In Russian), W72-01897	4A
Aquatic Life in Waters Polluted by Acid Mine Waste, W72-01796	5C	LAVRENT'Yeva, L. D.		LITTMAN, F. E.	
A Partial Checklist of Florida Fresh-Water Algae and Protozoa with Reference to McCloud and Cue Lakes, W72-01993	5A	Water and Hydroelectric Power Resources of the Upper Irtysh Basin (Vodnyye i vodno-gelicheskiye resursy basseyna Verkhnego Irtysha), W72-02067	4A	In-Situ Regenerable Membranes for Reverse Osmosis, W72-01837	3A
LAHIRI, A. N.		LAW, JAMES P. JR		LLIBOURY, L.	
Studies on Plant-Water Relationships. V. Influence of Soil Moisture on Plant Performance and Nitrogen Status of the Shoot Tissue, W72-02163	2I	Agricultural Utilization of Sewage Effluent and Sludge, an Annotated Bibliography, W72-02104	5G	Corrective Terms in the Glaciological Balance, W72-01715	2C
LAHIRI, S. M.		LAWRENCE, R. W.		Permeability, Brine Content and Temperature of Temperate Ice, W72-01706	2C
Refract Seismic Investigation at Zemu Glacier, Sikkim, W72-02000	2C	New and Improved Cellulose Ester Membranes, W72-02111	3A	LLOYD, L. W.	
LAHN, R. M.		LEACH, S. D.		A Study of Reinsertion Transient Voltages for Series Capacitors on USBR Glen Canyon - Flagstaff 345 KV Lines, W72-01775	8C
The Anacostia River, Ecological Imbalance of an Urban Stream Valley, W72-02093	5C	Hydrologic Effects of Water Control and Management of Southeastern Florida, W72-02090	4A	LOFGREN, G.	
LAING, M. B.		LEDBETTER, WILLIAM B.		Effect of Growth Parameters on Substructure Spacing in NaCl Ice Crystals, W72-02092	2C
Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements, W72-02014	7B	Sulfuric Acid Attack on Concrete Sewer Pipe, W72-01848	8F	LORD, S. M. JR	
LAKSHMANA RAO, N. S.		LETTERMAN, RAYMOND D.		A Critical Examination of Bathing Water Quality Standards, W72-01997	5B
Linear Proportional Weirs with Trapezoidal Bottoms, W72-01728	8B	Coagulation of Activated Carbon Suspensions, W72-01862	5E	LOWE, L. B.	
LAMAZE, C. E.		LEVER, N. A.		A Comparative Study of Two Methods of Applying CCC (2-Chloroethyl) Trimethylammonium Chloride) to Wheat, W72-02118	3F
Improved Membranes for Reverse Osmosis, W72-01833	3A	Disposal of Nitrogenous Liquid Effluent From Modderfontein Dynamite Factory, W72-01866	5D	LUBYANSKENE, V. N.	
LANCE, J. C.		LEVIN, A. G.		The Mineralization Activity of Bacterioplankton in Freshwater Ecosystems, (In Russian), W72-01940	2I
Renovating Sewage Effluent by Ground-Water Recharge, W72-02226	5D	Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniya vesennego stoka i yeye realizatsiya dlya prognoza gidrografa), W72-02096	2E	LUEBS, R. E.	
LANGHAM, E. J.		LEWALLEN, M. J.		Dryland Agriculture in California Grain Cropping with Winter Rainfall, W72-02245	3F
New Approach to Hydrologic Data Acquisition, W72-02018	7A	Pesticide contamination of a Shallow Bored Well in the Southeastern Coastal Plains, W72-02078	5B	LUNDBERG, P. E.	
LANGLEBEN, M. P.		LIAO, C. S.		Effect of Two Growth-Regulating Chemicals on Yield and Water Use of Three Perennial Grasses, W72-01908	3F
Albedo of Melting Sea Ice in the Southern Beaufort Sea, W72-01711	2C	Sorption and Desorption of Chlorinated Hydrocarbon Pesticides in Aquatic Sediment Minerals, W72-01779	5B	LYNN, R. J.	
LANGMUIR, D.		LIGHTFOOT, E. N.		On Potential Density in the Deep South Atlantic Ocean, W72-02037	2E
Ground-Water Pollution Potential of a Landfill above the Water Table, W72-02081	5B	Oxygen Diffusion Through a Pure Culture Floc of <i>Zoogloea Ramigera</i> , W72-01851	5D	LYONS, J. B.	
LASCA, N. P.		LINFIELD, WARNER M.		Basement Ice, Ward Hunt Ice Shelf, Ellesmere Island, Canada, W72-01710	2C
An Improved Method for Determining Ice Fabrics, W72-02002	2C	Development of Phosphate-Free Home Laundry Detergents, W72-01986	5B	MACARTNEY, J. C.	
LAUDE, H. M.		LINSLEY, RAY K.		The Effect of Different Cultivation Techniques on Soil Moisture Conservation and the Establishment and Yield of Maize at Kongwa, Central Tanzania, W72-01967	3F
Drought Influence on Physiological Processes and Subsequent Growth,		A Critical Review of Currently Available Hydrologic Models for Analysis of Urban Stormwater Runoff,		MACDONALD, F. W.	
				Sewerage Practice in the Gulf Coast Area,	

AUTHOR INDEX

MACKENTHUN, KENNETH M.

W72-01861

5D

MACKENTHUN, KENNETH M.

A Heavy Mortality of Fishes Resulting from the Decomposition of Algae in the Yahara River, Wisconsin,
W72-01797

5C

MACKOWIAK, Czeslaw

Effects of Mineral Fertilization in 4 Course Rotation on Sandy Soil: II. Results of Investigations in 4th Course of Rotation in an Experiment of Many Yrs in the Experiment Stn. Malyszyn Wielki, (In Polish),
W72-01944

3F

MACKOWIAK, WALENTY

Effects of Mineral Fertilization in 4 Course Rotation on Sandy Soil: II. Results of Investigations in 4th Course of Rotation in an Experiment of Many Yrs in the Experiment Stn. Malyszyn Wielki, (In Polish),
W72-01944

3F

MADAN MOHAN RAO, G.

Influence of Activity and Salinity on the Weight-Dependent Oxygen Consumption of the Rainbow Trout *Salmo Gairdneri*,
W72-01914

2I

MAITLAND, PETER S.

The Age and Growth of Perch (*Perca Fluvialis* L.) in two Scottish Lochs,
W72-01916

2H

MAKKINK, G. F.

Potential Evaporation, (In Dutch),
W72-01946

2D

MANAHAN, S. E.

Potentiometric Techniques for Monitoring Ions Involved in Water Pollution,
W72-01693

5A

MANJIKIAN, SEROP

Reverse Osmosis Pilot Plant for Desalination of Sea Water,
W72-01831

3A

MANN, R. H. K.

The Populations, Growth and Production of Fish in Four Small Streams in Southern England,
W72-01913

2I

MANNY, BRUCE A.

Phytoplanktonic Nitrogen as an Index of Cultural Eutrophication,
W72-01780

5C

MANSELL, R. S.

Movement and Adsorption of Pesticides in Sterilized Soil Columns,
W72-01697

5B

MANUEL, O. K.

Iodine and Algae in Sedimentary Rocks Associated with Iodine-Rich Brines,
W72-02073

2K

MARKLEY, L. L.

Membranes for Desalination by Reverse Osmosis,
W72-02046

3A

MARRSON, M.

Ecology of Plant Saprobia,
W72-01793

5C

MARSSON, M.

Ecology of Animal Saprobia,

W72-01799

5C

MARTIN, E. J.

Kinetics of the Steady State Bacterial Culture IV. Transfer Rates,
W72-01865

5D

MARX, ANDREW J.

Pre-Treatment Basin for Algae Removal,
W72-01814

5F

MATHIAS, E. L.

Effect of Two Growth-Regulating Chemicals on Yield and Water Use of Three Perennial Grasses,
W72-01908

3F

MATHUR, B. S.

Performance of Mexican Dwarf Wheats,
W72-02174

3F

MATIS, J. R.

Petroleum Contamination of Ground Water in Maryland,
W72-02080

5B

MATLOCK, W. G.

Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals,
W72-01781

2F

MATULOVA, DRAGICA

Biological Assays and Water Quality in Minnesota,
W72-01783

5C

MAYER, J. K.

Sewerage Practice in the Gulf Coast Area,
W72-01861

5D

MCCARTY, PERRY L.

Aerobic Decomposition of Algae,
W72-01881

5D

MCCLAIN, E. P.

Detection of Thawing Snow and Ice Packs Through the Combined use of Visible and Near-Infrared Measurements from Earth Satellites,
W72-02016

7B

MCCORMICK, J. HOWARD

Temperature Requirements for Growth and Survival of Larval Ciscos (*Coregonus Arted II*),
W72-01989

5C

MCCOY, JOHN J.

Populations Fluctuations in the Genus *Trachelomonas* (Order Euglenida),
W72-02189

2I

MCGINNIS, D. F.

Detection of Thawing Snow and Ice Packs Through the Combined use of Visible and Near-Infrared Measurements from Earth Satellites,
W72-02016

7B

MCGINNIS, L. D.

Permafrost-Hydrogeologic Regimen in Two Ice-Free Valleys, Antarctica, from Electrical Depth Sounding,
W72-02030

2C

MCKINNEY, ROSS E.

Protozoa and Activated Sludge,
W72-01817

5D

MCMANUS, J.

Channel Stability in the Estuary: Controls by Bedrock and Unconsolidated Post-Glacial Sediment,
W72-01748

2D

W72-01721

2L

MCMILLEN, R.

In-Situ Regenerable Membranes for Reverse Osmosis,
W72-01837

3A

MCSWEENEY, A.

Optical Fourier Transform Technique for Measuring Sediment Concentration,
W72-02158

2J

MCWHORTER, J. C.

A Uniform Flow Formula for Flumes and Canals,
W72-02051

8B

MEEKS, D. C.

Microwave Radiometric Detection of Oil Slicks,
W72-02024

5A

MERHOTRA, O. N.

Influence of Soil Moisture on Growth, Yield and Quality of Groundnut,
W72-01962

3F

MELLOR, M.

Creep of Ice Under Low Stress,
W72-02091

2C

MERNY, G.

Plant Parasitic Nematodes of Flooded Rice Fields on the Ivory Coast: II. Attempt at Estimating the Size of Populations (In French),
W72-01951

3F

METTLER, B.

Comparison of Water Pricing Structures from a Collective Utility Viewpoint,
W72-02233

6C

MEYER, ALVIN H.

Sulfuric Acid Attack on Concrete Sewer Pipe,
W72-01848

8F

MEZENTSEV, V. S.

Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestevennyye usloviya uvlazhneniya territorii Obskogo basseyna i perspektiv gidromelioratsiyi),
W72-02063

4A

MIKHAYLOVA, YE. V.

Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektivnye ispol'zovaniya podzemnykh vod yugovostochnoy chasti Zapadnoy Sibiri),
W72-02102

4B

MILLAR, A. A.

Influence of Atmospheric and Soil Environmental Parameters on the Diurnal Fluctuations of Leaf Water Status of Barley,
W72-01970

3F

MILLARD, N. A. H.

The Ecology of South African Estuaries: X. St. Lucia: A Second Report,
W72-02204

2L

MILLER, D. R.

Lysimetric and Energy Balance Determination of Slatfence and Tree Windbreak Effects on Water Use Efficiency,
W72-01748

2D

MILLER, M. E.

Snow in Ohio,

AUTHOR INDEX

OTT, CHARLES R.

W72-02027	2C	W72-02085	2E	W72-02083	5B
MILLER, S. A. Response of Alfalfa Varieties to Different Water Table Depths at Various Stages of Growth, W72-02162	3F	MYERS, L. F. Assessment of Summer Irrigated Pastures to Supplement Sheep Grazing Irrigated Annual Pastures, W72-01957	3F	NYMAN, O. L. Ecological Interaction of Brown Trout, <i>Salmo Trutta</i> L., and Brook Trout, <i>Salvelinus Fontinalis</i> (Mitchill), in a Stream, W72-01949	21
MILLER, W. D. Subsurface Distribution of Nitrates Below Commercial Cattle Feedlots, Texas High Plains, W72-02003	5B	NAGIEV, K. G. Interrelations Between Tree Species in Forest Belts on Unirrigated Lands (In Russian), W72-01900	4A	OAKLEY, ROY H. The Prevention of Pollution in Estuaries, W72-01883	5G
MILLHAM, C. B. On the Economic Impact of Large Diversions of Snake River Waters, W72-02124	6D	NEAL, V. T. Temperature and Conductivity Measurements Under Ice Island T-3, W72-02042	2K	O'CONNOR, D. J. Pilot Mechanical Aeration Studies of the Jackson River in Covington, West Virginia, W72-01845	5G
MINESSY, F. A. Effect of Some Soil Properties on Root and Top Growth and Mineral Content of 'Washington' Naval Orange and 'Balady' Mandarin, W72-01891	2I	NECHAYEVA, N. S. Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniya vesennego stoka i yeye realizatsiya dilya prognoza gidrografa), W72-02096	2E	ODLAUG, T. O. A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use, W72-01735	5C
MISRA, S. G. Osmotic Pressure in Relation to the Growth of Barley Plants in Saline and Alkali Soils, W72-02173	3F	NELSON, J. M. Sugar Beets in Arizona, W72-01742	3F	OEBKER, N. F. Mulching Techniques for Arid Lands Vegetable Production, W72-02221	3F
MOIR, IAN W. M. The Prevention of Pollution in Estuaries, W72-01883	5G	NELSON, MICHAEL D. Toward Computer Control of Wastewater Treatment, W72-01824	5D	OERMENYI, I. Dynamic Orientation of Medical Climatology, W72-01945	2B
MOMMAERTS, JEAN-PAUL On the Nannoplankton of the Tamur Estuary (Plymouth, Great Britain), W72-01918	2L	NEOFITOV, V. A. Strip Afforestation on Distant Pastures of the Western Kazakhstan, W72-01903	4A	OLAFSSON, G. Range Resources of Iceland, W72-02181	3F
MOORE, J. E. Nutritive Value of Fertilized Jaragua Grass (<i>Hyparrhenia Rufa</i> (Nees) Stapf.) in the Wet-Dry Pacific Region of Costa Rica, W72-01975	3F	NESHYBA, S. Temperature and Conductivity Measurements Under Ice Island T-3, W72-02042	2K	OLDHAM, L. W. Chemical Aspects of Some Waste Disposal Problems, W72-01872	5D
MOULTON, J. C. Enhancement of Ecologic and Aesthetic Values of Water Associated with Interstate Highways, W72-01698	4C	NEUFELD, RONALD D. Removal of Orthophosphates From Aqueous Solutions with Activated Alumina, W72-01847	5D	O'LEARY, C. J. Relationship Between <i>Escherichia Coli</i> , Type I and <i>Enterococci</i> in Water, W72-01854	5B
MUELLER, J. A. Oxygen Diffusion Through a Pure Culture Floc of Zoogloea Ramigera, W72-01851	5D	NICHOLLS, R. L. Mathematical Foundations for Design: Civil Engineering Systems, W72-02127	6A	OLESON, S. M. Heavy Minerals of Northern Sand Key, Pinellas County, Florida, W72-01732	2J
MUELLER, R. F. The Anacostia River, Ecological Imbalance of an Urban Stream Valley, W72-02093	5C	NIXON, F. P. Virus Removal by Coagulation with Polyelectrolytes, W72-01886	5F	OLSON, R. A. Residual Mineral N Accumulation in Soil and its Utilization by Irrigated Corn (<i>Zea Mays</i> L.), W72-02167	3F
Thermodynamics of Environmental Degradation, W72-02137	5G	NOBLE, J. C. Response by Irrigated Grain Sorghum to Broadcast Gypsum and Phosphorous on Heavy Clay Soil, W72-02117	3F	OLSON, T. A. A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use, W72-01735	5C
MULLER, A. Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation, W72-01727	2J	NORTHWOOD, P. N. The Effect of Different Cultivation Techniques on Soil Moisture Conservation and the Establishment and Yield of Maize at Kongwa, Central Tanzania, W72-01967	3F	ONDO, YOSHINORI Studies on the Aquatic Insect Community of Mountain Stream at the Foot of Mt. Daisen: I. Ecological Investigation on a Population of Ephemeroptera (In Japanese), W72-01953	21
MUNN, R. E. Biometeorological Methods, W72-01947	2B	NORUM, E. B. Influence of Atmospheric and Soil Environmental Parameters on the Diurnal Fluctuations of Leaf Water Status of Barley, W72-01970	3F	OSBORN, H. B. Some Regional Differences in Runoff-Producing Thunderstorm Rainfall in the Southwest, W72-02214	2B
MUSGRAVE, W. F. Irrigation Planning 2: Choosing Optimal Acreages Within a Season, W72-02130	6A	NOSHKIN, V. E. Plutonium-239 in and Over the Atlantic Ocean,		OSMOND, J. K. Uranium and Tritium as Natural Tracers in the Floridan Aquifer, W72-01696	4B
MYCYK, R. T. Floods in Harvard Southwest Quadrangle, Northeastern Illinois,				OTT, CHARLES R. Theoretical Evaluation of Filter Modeling Experiments,	

AUTHOR INDEX

OWEN, OLIVER S.

W72-01859
OWEN, OLIVER S.
Natural Resource Conservation: An Ecological Approach,
W72-01896
6G

PALIN, A. T.
Determining Chlorine Dioxide and Chlorite,
W72-01873
5F

PALIWAL, K. V.
Quality of Irrigation Waters of Kanjhwala and Alipur Blocks of Delhi in Relation to Soil Properties and Growth of Wheat,
W72-01964
3C

PALMER, C. MERVIN,
Suggested Classification of Algae and Protozoa in Sanitary Science,
W72-01798
5C

PANGBORN, R. M.
Sensory Examination of Mineralized, Chlorinated Waters,
W72-01868
5F

PARIZEK, R. R.
Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks in Central Pennsylvania,
W72-02115
4B

PARRY, D. L.
Field Evaluation of Heavy-Walled Pressure Vessels Using Acoustic Emission Analysis,
W72-01776
8G

PASTERNAK, DOV
Some Factors Responsible for Varying Effectiveness of Stomatally Closing Antitranspirants,
W72-01774
3F

PATHAK, A. N.
Uptake of Nitrogen and Phosphorus by Paddy Under Water-Logged Condition,
W72-02172
3F

PATRIC, J. H.
Economic Evaluation of Some Watershed Management Alternatives on Forest Land in West Virginia,
W72-02146
4A

PATRICK, RUTH
Aquatic Organisms as an Aid in Solving Waste Disposal Problems,
W72-01801
5C

PAUL, PAUL E.
Inka Aeration at Hazleton, Pennsylvania,
W72-01844
5D

PECK, EUGENE L.
Influences of Exposure on Pan Evaporation in a Mountainous Area,
W72-02119
2D

PEEBLES, R. W.
Mulching Techniques for Arid Lands Vegetable Production,
W72-02221
3F

PENDLETON, J. W.
Trends in Practices and Production of Major Crop Belt Crops,
W72-01941
3F

PENKA, P.
Water Loss in Forest Tree Seedlings and Their Waterholding Capacity (In Czech),

SE
W72-01905
PENMAN, A. D. M.
Rockfill,
W72-01765
8D

PEPPER, LEONARD
Survey of Applications of Epoxy Resins for Civil Works Projects,
W72-02120
8G

PERRIER, E. R.
Modification of a 360-Degree Antenna Rotor for Continuous Stepped Rotation,
W72-01884
3F

PETERSON, S. H.
Recharging the Ogallala Formation Using Shallow Holes,
W72-02227
4B

PETKEVICH, A. N.
Fish Management in the Ob River Basin in the Light of Possible Construction of the Lower Ob Hydroelectric Power Plant (Rybnoye khozyaystvo Obskogo basseyna pri uslovii sozdaniya Nizhne-Obskoy GES),
W72-02064
4A

PEZIER, J.
Outline of a Bayesian Approach to the EML Multiple Cloud Seeding Experiments,
W72-02058
3B

PHILBERTH, K.
On the Temperature Profile and the Age Profile in the Central Part of Cold Ice Sheets,
W72-01705
2C

PILON, J.
Relation Between Beginning of Emergence of Odonates, Development of Leaves in Spring, and Water Temperature Studies: Reading, UK, July 23-30, 1966,
W72-02246
2I

PLASTER, R. W.
Bedrock Weathering and Residual Soil Formation in Central Virginia,
W72-01716
2J

POLIKARPOV, G. G.
Unresolved Problems of Water Radioecology, (In Russian),
W72-01941
5B

POLZER, C. W.
Use and Abuse of Southwestern Rivers. Historic Man--The Spaniard,
W72-02237
4A

PONTIN, J. M. A.
An Extended Theory of Delayed Yield from Storage Applied to Pumping Tests in Unconfined Anisotropic Aquifers,
W72-02011
4B

POON, CALVIN C.
Viability of Long-Stored Airborne Bacterial Aerosols,
W72-01882
5D

POPOV, YE. G.
Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniya vesennego stoka i yeye realizatsiya diya prognoza gidrografa),
W72-02096
2E

PORTERFIELD, JOHN D.
Water Pollution, Its Effect on Public Health,

2D
W72-01808
POTTER, B. J.

Modification of Carcase Characteristics in Sheep Maintained on a Saline Water Regime,
W72-01958
3C

POWER, J. F.
Soil Water Extraction by N-Fertilized Spring Wheat,
W72-02165
3F

PRAKASH, JAI
Soil Suitability for Eucalyptus Hybrid (Synonym E. Tereticornis or Mysore Gum) Plantations in Tarat and Bhabar Region of Uttar Pradesh,
W72-01904
2G

PRIOR, D. B.
A Method of Monitoring Mudflow Movements,
W72-01722
2J

PRITCHARD, D. W.
A Biaxial Propeller Current-Meter System for Fixed-Mount Applications,
W72-02038
7B

PROTAS'YEV, M. S.
Surface-Water Resources of the Ob River and Ob-Irtish Interfluve (Resursy poverkhnostnykh vod r. Ob i Ob'-Irtishskogo mezhdurech'ya),
W72-02065
4A

PUTNAM, HUGH D.
Eutrophication: Small Florida Lakes as Models to Study the Process,
W72-01990
5B

PYATT, EDWIN E.
Model for Flow Augmentation Analysis-An Overview,
W72-01874
5G

QASHU, H. K.
Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals,
W72-01781
2F

QUINLIVAN, B. J.
The Effect of Burr Burial on the Seed of Some Early Maturing Subterranean Clover Cultivars,
W72-01736
3F

QUON, J. E.
Coagulation of Activated Carbon Suspensions,
W72-01862
5E

RAGUSE, C. A.
Perennial Irrigated Pastures: I. Plant, Soil Water, and Animal Responses Under Rotational and Continuous Grazing,
W72-02180
3F

RAHN, JAMES J.
Estimating Corn Canopy Extreme Temperatures From Shelter Values,
W72-01969
3F

RAI, S. D.
Response of Alfalfa Varieties to Different Water Table Depths at Various Stages of Growth,
W72-02162
3F

RAO LAKSHMANA, N. S.
Shapes of Grit Chambers to Achieve Certain Velocity-Head Relations with given Shapes of Outlet Weirs,

AUTHOR INDEX

SALTONSTALL, C. W. JR

W72-01729	8B	W72-01870	5F	W72-01756	4B
RAYCHEVA-MEHANDZHIEVA, A. Comparative Testing of Irrigated Local and Introduced Double Maize Hybrids (In Bulgarian), W72-01965	3F	RITTALL, W. F. The Barged Ocean Disposal of Wastes: A Review of Current Practice and Methods of Evaluation, W72-01987	5C	ROWLEY, JENNIFER Lysimeter and Interception Studies in Narrow-leaved Snow Tussock Grassland, W72-01931	2B
RAYMOND, C. F. Determination of the Three-Dimensional Velocity Field in a Glacier, W72-02147	2C	ROBERTS, P. F. Operating Experiences with Vacuum Filtration at St. Helens: A Solution to the Problem, W72-01849	5D	ROY, S. K. Interculture in Transplanted Rice (<i>Oryza Sativa</i> L.), W72-02171	3F
Flow in a Transverse Section of Athabasca Glacier, Alberta, Canada, W72-01708	2C	ROBERTSON, A. F. Preliminary Evaluation of Hydrologic Conditions of the Lakeland Ridge Area of Polk County, Florida, W72-02086	4B	ROYCE, C. F. JR Terraces and Pediment-Terraces in the Southwest: An Interpretation, W72-01719	2J
A New Bore-Hole Inclinometer, W72-02001	2C	ROBINSON, A. H. Seasonal Distribution of Zooplankton in the Northern Basin of Lake Chad, W72-01942	2H	RUBIN, A. J. Effect of Sulfate and Other Ions in Coagulation with Aluminum, W72-01869	5D
RAZUMOVA, L. A. Agrometeorological Conditions in the Volga Region and the Effectiveness of Measures to Combat Unfavorable Hydrometeorological Phenomena (Agrometeorologicheskiye usloviya Povolzh'ya i effektivnost' meropriyatiy po bor'be s neblagopriyatnymi gidrometeorologicheskimi yavleniyami), W72-02098	3F	ROBINSON, PATRICIA K. Seasonal Distribution of Zooplankton in the Northern Basin of Lake Chad, W72-01942	2H	RUDD, R. L. Chemicals in the Environment, W72-02251	5B
REED, S. A. Stabilization of Product Water From Seawater Distillation Plants, W72-01835	3A	ROEFS, T. G. Conditional Streamflow Probability Distributions, W72-02223	6A	RUDOLFS, WILLEM Effect of Sunlight and Green Organisms on Recrystallization of Streams, W72-01794	5C
REEVES, C. C. Saline Lake Basins of the Southern High Plains, W72-01752	2F	Optimal Utilization of Playa Lake Water in Irrigation, W72-02231	3F	RULIFSON, R. L. Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02159	5B
REGINATO, R. J. Field Measurements of Soil-Water Content and Soil-Water Pressure, W72-02222	2G	ROGERS, J. S. Modification of a 360-Degree Antenna Rotor for Continuous Stepped Rotation, W72-01884	3F	Summary Report, Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02160	5B
REYNOLDSON, T. B. The Incidence and Intensity of Predation on Lake-dwelling Tricladids in the Field, W72-01948	2H	ROGERS, W. E. Enhancement of Ecologic and Aesthetic Values of Water Associated with Interstate Highways, W72-01698	4C	RUNNELLS, D. D. Chemical Weathering of the Biscayne Aquifer, Dade County, Florida, W72-01731	2F
RICE, R. C. Renovating Sewage Effluent by Ground-Water Recharge, W72-02226	5D	ROHDY, D. D. Secondary Economic Effects of Irrigation on the Colorado High Plains, W72-02136	6B	RUSHTON, A. Effect of Filter Cloth Structure on Flow Resistance, Bleeding, Blinding and Plant Performance, W72-01878	5D
RICHARDSON, ARTHUR J. Water and Air Changes in Grapefruit, Corn, and Cotton Leaves with Maturation, W72-01772	3F	ROHLICH, GERARD A. Chemical Composition of Algae and its Relationship to Taste and Odor, W72-01812	5A	RUSSELL, R. A. On the Economic Impact of Large Diversions of Snake River Waters, W72-02124	6D
RICHARDSON, E. A. Estimated Return Periods for Short-Duration Precipitation in Utah, W72-02026	2B	ROMANENKO, N. A. Contamination with Helminth Eggs of Agricultural Products from Sewage-Irrigated Fields, (In Russian), W72-01890	5B	RYAN, W. B. F. Dispersal Patterns of Clay Minerals in the Sediments of the Eastern Mediterranean Sea, W72-01999	2J
RICKARD, M. D. The Biochemical Aspects of Aerobic Bacterial Growth, W72-01870	5F	ROSEMAN, KARL A. Development of Phosphate-Free Home Laundry Detergents, W72-01986	5B	SADAN, D. Changes in the Ratio Between Sugar Beet Evapotranspiration and Pan Evaporation During the Growing Season, W72-02179	3F
RIEDINGER, A. B. Large Reverse Osmosis System Technology and Module Development, W72-02047	3A	ROSENBERG, NORMAN J. Energy and CO ₂ Balance of an Irrigated Sugar Beet (<i>Beta Vulgaris</i>) Field in the Great Plains, W72-02178	3F	SALCHEVA, G. Soil Moisture as Affecting Certain Physiologically-Biochemical Processes in Winter Wheat During the Autumn-Winter Period, (In Russian), W72-02168	3F
RILEY, W. H. The Biochemical Aspects of Aerobic Bacterial Growth,		ROSS, S. H. Geothermics in North America: Present and Future,		SALTONSTALL, C. W. Development of New and Improved Cellulose Ester Reverse Osmosis Membranes, W72-02049	3A
				SALTONSTALL, C. W. JR New and Improved Cellulose Ester Membranes,	

AUTHOR INDEX

SAMOILOV, Y. I.

W72-02111	3A	W72-02033	2E	W72-02039	7B
SAMOILOV, Y. I.		SCHUFLE, J. A.		SHUE, V.	
A Tentative Classification of Meadows in the Floodplains of the Msta River (in Russian), W72-01976	6F	Long Term Movement of Water and Soil Salinity in the Weathering Zone of Arid Zone Sediments, W72-01753	2G	Coastal Zone Management--The Tidelands: Legislative Apathy Vs. Judicial Concern, W72-02153	6E
SANDS, A. W.		SCHWAB, G. E.		SHULMAN, MARK D.	
A Decade of EHV Transmission in the Soviet Union--An Annotated Bibliography, W72-01766	8C	A Survey of Saline Ground Water as a Mineral Resource, W72-01754	2K	Investigation of the Effects of Urbanization on Precipitation Type, Frequency, Areal and Temporal Distribution, W72-01982	2B
SANGER, JON E.		SCLATER, J. G.		SIDDQUI, S. H.	
The Diversity of Pigments in Lake Sediments and Its Ecological Significance, W72-01784	5C	Pacific Bottom Water: Penetration Around Hawaii, W72-02040	2E	Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks in Central Pennsylvania, W72-02115	4B
SARAN, S.		SCOTT, DONALD C.		SIMONOV, A. I.	
Interculture in Transplanted Rice (<i>Oryza Sativa L.</i>), W72-02171	3F	The Freshwater Fishes of Georgia, W72-01955	2I	Present-day and Long-term Water and Salt Balance of Southern Seas of the USSR (Azov, Caspian and Aral) and Possible Changes in Their Hydrologic and Hydrochemical Regimes (Sovremennyy i perspektivnye vodnyy i solevoy balansy i vozmozhnye izmeneniya gidrologicheskogo i gidrokhimicheskogo rezhimov yuzhnykh morey SSSR (Azovskogo, Kaspiyskogo i Aral'skogo), W72-02099	2H
SARLES, WILLIAM B.		SEBREE, D. B.		SIMPSON, J.	
Chemical Composition of Algae and its Relationship to Taste and Odor, W72-01812	5A	A Welter of Ideas--A Modicum of Coordination, W72-02151	5G	Outline of a Bayesian Approach to the EML Multiple Cloud Seeding Experiments, W72-02058	3B
SAROFIM, ADEL F.		SECCHI, A. J.		SINGH, CHOKHEY	
Continuous Washing of Brine from Ice, W72-01832	3A	New and Improved Cellulose Ester Membranes, W72-02111	3A	Yield of Cotton in Relation to Rainfall in Madhya Pradesh, W72-02161	3F
SAVIN, S. M.		SEITZ, R. C.		SINGH, G. N.	
Basement Ice, Ward Hunt Ice Shelf, Ellesmere Island, Canada, W72-01710	2C	Measurement of a Three-Dimensional Field of Water Velocities at a Depth of One Meter in an Estuary, W72-02015	2L	Uptake of Nitrogen and Phosphorus by Paddy Under Water-Logged Condition, W72-02172	3F
SCHAFFLER, O. S.		SEN, P. K.		SINGH, SUDAMA	
New and Improved Cellulose Ester Membranes, W72-02111	3A	Studies in Water Relations of Rice: V. Effect of Varying Water Regimes on the Growth of Main Shoot in Indica Rice, W72-02170	3F	Studies on Plant-Water Relationships. V. Influence of Soil Moisture on Plant Performance and Nitrogen Status of the Shoot Tissue, W72-02163	2I
SCHICHT, R. J.		SHAFI, MUHAMMED		SKRESLET, STIG	
Feasibility of Recharging Treated Sewage Effluent into a Deep Sandstone Aquifer, W72-02077	5D	The Age and Growth of Perch (<i>Perca Fluviatilis L.</i>) in Two Scottish Lochs, W72-01916	2H	The Ecosystem of the Arctic Lake Nordlaguna, Jan Mayen Island: II. Plankton and Benthos, W72-02190	2H
SCHIEBE, F. R.		SHARMA, D. P.		SLUSANSCHI, H.	
A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use, W72-01735	5C	Osmotic Pressure in Relation to the Growth of Barley Plants in Saline and Alkali Soils, W72-02173	3F	Calibration of the 'Electronic T sub 1' Humidometer for Cereals: Pulses and Oleaginous Seeds, (In Rumanian), W72-02164	3F
SCHINDLER, J. E.		SHAW, R. H.		SLYADNEV, A. P.	
Observations of the Mud-Water Interface, W72-02052	2H	Effects of Leaf Orientation on Leaf Resistance to Water Vapor Diffusion in Soybean (<i>Glycine Max L. Merr</i>) Leaves, W72-02176	3F	Characteristics of Atmospheric Precipitation in the Southeastern Part of the West Siberian Plain (Nekotoryye osobennosti atmosfernogo uvlazhneniya na yugo-vostoke Zapadno-Sibirskoy ravniny), W72-02100	2B
SCHMID, L. A.		SHEPHERD, R.		SMITH, C. W.	
Biological Treatment of Beef Animal Wastes, W72-01777	5D	A Method of In Situ Stiffness Measure, W72-01770	8D	Advance Wastewater Treatment, W72-01879	SD
SCHMIDT, K. D.		SHERWOOD, THOMAS K.		SMITH, H. F.	
The Use of Chemical Hydrographs in Ground-water Quality Studies, W72-02225	5A	Continuous Washing of Brine from Ice, W72-01832	3A	Subsurface Storage and Disposal in Illinois,	
SCHNELLE, KARL B.		SHERWOOD, W. C.			
Predicting Effects of Dead Zones on Stream Mixing, W72-01853	5B	Bedrock Weathering and Residual Soil Formation in Central Virginia, W72-01716	2J		
SCHOTT, F.		SHESHAGIRI, A.			
Spatial Structure of Inertial-Period Motions in a Two-Layered Sea, Based on Observations,		Yield of Cotton in Relation to Rainfall in Madhya Pradesh, W72-02161	3F		

AUTHOR INDEX

TERAN, M. A.

W72-02076	5E	W72-02135	5G	W72-01989	5C
SMITH, J. W. The Genesis of Sudden Stratospheric Warnings and the Quasi-Biennial Cycles, W72-02023	2B	STEVENSON, ALBERT H. Water Quality Requirements for Recreational Uses, W72-01807	5G	TABASARAN, O. The De-Watering of Digested Sludge Using Synthetic Filtering Agents, W72-01846	5E
SMITH, KENNETH A. Continuous Washing of Brine from Ice, W72-01832	3A	STEVENSON, K. R. Effects of Leaf Orientation on Leaf Resistance to Water Vapor Diffusion in Soybean (Glycine Max L. Merr) Leaves, W72-02176	3F	TAFT, B. A. New Evidence of the Equatorial Undercurrent East of the Galapagos Islands, W72-02034	2E
SMITH, M. J. Potentiometric Techniques for Monitoring Ions Involved in Water Pollution, W72-01693	5A	STEVENSON, M. R. New Evidence of the Equatorial Undercurrent East of the Galapagos Islands, W72-02034	2E	TAGUCHI, SATORU Amount of Pigments and Daily Production of Phytoplankton Occurring in Acidic Lake Toya (In Japanese), W72-02197	5C
SMITH, R. J. Natural Relationships of Indicator and Pathogenic Bacteria in Stream Waters, W72-01996	5B	STOCKTON, C. W. Augmenting Annual Runoff Records Using Tree-Ring Data, W72-02213	2E	TAMBURI, A. J. Basement Ice, Ward Hunt Ice Shelf, Ellesmere Island, Canada, W72-01710	2C
SOSEDOV, I. S. Water and Hydroelectric Power Resources of the Upper Irtysh Basin (Vodnyye i vodnoenergeticheskiye resursy basseyna Verkhnego Irtysha), W72-02067	4A	STRASKRABA, M. List of Freshwater Crustaceans of Cuba and Their Zoogeographical Relationships, W72-01887	2I	TANAKA, ICHIRO Ecological Study of Irrigation Method of Rice Plant: Influence of Underground Water Level and Rainfall in Rice Growing Season on the Growth of Rice Plant, (In Japanese), W72-02169	3F
SPROUL, O. J. Virus Removal by Coagulation with Polyelectrolytes, W72-01886	5F	STRICKLAND, JOHN D. H. A Permanent record of Plankton Samples Using Holography, W72-02202	2I	TANIGAWA, KIMIE Studies on the Aquatic Insect Community of Mountain Stream at the Foot of Mt. Daisen: I. Ecological Investigation on a Population of Ephemeroptera (In Japanese), W72-01953	2I
SPROUL, OTIS J. Virus Inactivation During Phosphate Precipitation, W72-01852	5D	STROMMEN, N. D. Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States, W72-02210	2B	TANNER, D. B. Secondary Economic Effects of Irrigation on the Colorado High Plains, W72-02136	6B
SQUIRES, V. R. Assessment of Summer Irrigated Pastures to Supplement Sheep Grazing Irrigated Annual Pastures, W72-01957	3F	STRONG, A. E. Detection of Thawing Snow and Ice Packs Through the Combined use of Visible and Near-Infrared Measurements from Earth Satellites, W72-02016	7B	TARAS, MICHAEL J. Standard Methods for the Examination of Water and Wastewater, W72-01888	5A
SREENIVASAN, A. Limnological Studies on Parambikulam Aliyar-Project-I Aliyar Reservoir (Madras State), India, W72-02198	2H	SUDAK, R. G. Large Reverse Osmosis System Technology and Module Development, W72-02047	3A	TARBOX, G. S. Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769	8E
ST, J. P. Pilot Mechanical Aeration Studies of the Jackson River in Covington, West Virginia, W72-01845	5G	SUMMERS, W. K. Geothermics in North America: Present and Future, W72-01756	4B	TARZWELL, CLARENCE M. Some Important Biological Effects of Pollution Often Disregarded in Stream Surveys, W72-01790	5C
STAHL, G. R. Modification of a 360-Degree Antenna Rotor for Continuous Stepped Rotation, W72-01884	3F	SUMNER, J. S. Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals, W72-01781	2F	TASHKOV, G. Comparative Evaluation of the Importance of Individual Measures in the Total Agrotechnical Complex of Maize Irrigation (In Bulgarian), W72-01966	3F
STARK, R. M. Mathematical Foundations for Design: Civil Engineering Systems, W72-02127	6A	SUNG, HUNG-YEAN Constant Total Pressure Evaporation Process with Heat Reuse by a Built-in Engine, W72-01834	3A	TEBO, L. B. JR Effect of Siltation, Resulting from Improper Logging, on the Bottom Fauna of a Small Trout Stream in the Southern Appalachians, W72-01802	5C
STARKEY, ROBERT L. Transformations of Iron by Bacteria in Water, W72-01811	2K	SWAMINATHAN, M. S. Genetic Destruction of Yield Barriers in Cereals, W72-02175	3F	TEITZEL, J. K. Fertility Studies of Pasture Soils in the Wet Tropical Coast of Queensland: I. Soil-Vegetation Classification Units, W72-01737	3F
STEIMLE, S. E. Sewerage Practice in the Gulf Coast Area, W72-01861	5D	SYVERS, J. K. Characterization of Inorganic Phosphate in Noncalcareous Lake Sediments, W72-02113	2H	TERAN, M. A. Fertility Studies of Pasture Soils in the Wet Tropical Coast of Queensland: II. Granitic Soils, W72-01767	3F
STEPHENS, N. A Method of Monitoring Mudflow Movements, W72-01722	2J	SYRETT, ROLL F. Temperature Requirements for Growth and Survival of Larval Ciscos (Coregonus Arted II),		TERAN, M. A. Use of Controlled Environment for Vegetable Production in Desert Regions of the World,	
STEPP, J. M. Economics and Politics in Water Pollution Control,					

AUTHOR INDEX

TERGAS, L. E.

W72-02243

3F

W72-01714

2C

W72-02066

4A

TERGAS, L. E.

Nutritive Value of Fertilized Jaragua Grass (*Hyparrhenia Rufa* (Nees) Stapf.) in the Wet-Dry Pacific Region of Costa Rica,
W72-01975

3F

TOMO, ALDO P.

Trophic Chains Observed in the Bay of Port Paradise (Palmer Peninsula, Antarctica) in Relation to the Variations of the Fertility of its Waters, (In Spanish),
W72-01935

2L

VALENZUELA, G. R.

Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements,
W72-02014

7B

TESTA, R.

Creep of Ice Under Low Stress,
W72-02091

2C

TRABUE, I. M.

Sensory Examination of Mineralized, Chlorinated Waters,
W72-01868

5F

VAN BAVEL, C. H. M.

Dynamic Simulation of Vertical Infiltration into Unsaturated Soils,
W72-01782

2G

TEWS, LEONARD L.

Microfungi in the Water, Mud, and Litter of a Cattail Marsh,
W72-02112

5C

TRENTWORTH, D. F.

Virus Removal by Coagulation with Polyelectrolytes,
W72-01886

5F

VAN DYNE, G. M.

Range Resources of Iceland,
W72-02181

3F

THACKSTON, EDWARD L.

Predicting Effects of Dead Zones on Stream Mixing,
W72-01853

5B

TRUCHAN, M.

Aleutian Plain Sediments and Lithospheric Plate Motions,
W72-02043

2J

VAN HEEMST, H. D. J.

Potential Evaporation, (In Dutch),
W72-01946

2D

THAMES, J. L.

Hydrologic Characterization of Forested Watersheds in Arizona,
W72-01703

2A

TSIVOGLOU, E. C.

Oxygen Sag and Stream Self-Purification,
W72-01785

5C

VAN HOOK, W. ALEXANDER

Isotope Effect on the Thermodynamic Activity of Water,
W72-01695

1A

THEEP, R. T.

Coastal Zone Management-The Tidelands: Legislative Apathy Vs. Judicial Concern,
W72-02153

6E

TSUCHIYA, I.

Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere,
W72-01741

2B

VAN WYK, J. J. P.

The Influence of Bush Veld Trees on the Productivity of *Panicum-Maximum-M*: A Preliminary Report,
W72-02239

3F

THOMAS, EBERHARD

The Surface Drift of a Stream in Lapland, (In German),
W72-01943

2C

TUCKER, W. E.

Subsurface Disposal of Liquid Industrial Wastes in Alabama-A Current status Report,
W72-02075

5E

VANDEN BERG, A.

An Algorithm for Least Squares Analysis of Drawdown in Observation Wells,
W72-02008

4B

THORSTEINSSON, I.

Range Resources of Iceland,
W72-02181

3F

TUMAS, R. A.

Significance of Surface Runoff in the Water Regime of Drained Soil, (In Russian),
W72-01734

2G

VARNEY, K. E.

Drying Rates of Birdsfoot Trefoil Seed,
W72-02089

3F

THORUD, D. B.

Hydrologic Characterization of Forested Watersheds in Arizona,
W72-01702

2C

TURNER, WILLIAM R.

The Effects of Acid Mine Pollution on the Fish Population of Goose Creek, Clay County, Kentucky,
W72-01806

5C

VENKATARATHNAM, K.

Dispersal Patterns of Clay Minerals in the Sediments of the Eastern Mediterranean Sea,
W72-01999

2J

THORUP, R. T.

Virus Removal by Coagulation with Polyelectrolytes,
W72-01886

5F

TWEDT, R. M.

Natural Relationships of Indicator and Pathogenic Bacteria in Stream Waters,
W72-01996

5B

VERMA, B. P.

A Unirom Flow Formula for Flumes and Canals,
W72-02051

8B

THRONSON, R. E.

Control of Sediments Resulting from Highway Construction and Land Development,
W72-02106

2J

TYSHKO, V. P.

Complex-Use Management of the Karasuk-Burla Lakes (Kompleksnoye khozyaystvennoye ispol'zovaniye Karasuksko-Burlinskikh ozer),
W72-02069

4A

VIETS, F. G. JR.

Effective Drought Control for Successful Dry-

TIBBS, NICHOLAS H.

Water Geochemistry of Mining and Milling Retention in the 'New Lead Belt' of Southeast Missouri,
W72-01692

5B

VOIGT, M.

land Agriculture,
W72-01759

3F

TIMOFEEV, N. A.

Problems in the Irrigation of the Kulunda Steppe (Nekotoryye voprosy orosheniya Kulundinskoy stepi),
W72-02101

3F

USHER, M. B.

Pattern and Seasonal Variability in the Environment of a Scots Pine Forest Soil,
W72-01906

2G

VIRO, P. J.

Time and Effect of Forest Fertilization,
W72-01907

2I

TOBIN, T. M.

A Hot-Wire Engine to Produce Periodic Grooves on an Ice Surface,

2A

VAGAPOV, M. N.

Long-Term Water Balance of the Irtysh River in Kazakhstan (Perspektivnyy vodokhozyaystvennyy balans r. Irtysha v Kazakhstanskoy chasti),
W72-02056

2C

VODOP'YAN, N. S.

Bluegreen Algae of the Crimean Mineralized Reservoirs (In Ukrainian),
W72-02183

2H

TINLIN, R. M.

Hydrologic Characterization of Forested Watersheds in Arizona,
W72-01703

2A

UZUNER, M. S.

Two Investigations of River Ice: Part I and Part 2,
W72-02056

2C

VOIGT, M.

Preliminary Research in the Laboratory on Experimental Brackish Ecosystems,
W72-02203

5A

VON THUN, J. L.

Deformation Moduli Determined by Joint-Shear Index and Shear Catalog,
W72-01769

8E

VALLENZUELA, G. R.

Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements,
W72-02014

7B

VALLENZUELA, G. R.

Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements,
W72-02014

7B

ORGANIC AUTHOR INDEX

WONG, K. M.

W72-01939 2I

VOSKRESENSKIY, K. P.
Surface-Water Resources of the Ob River and Ob-Irtysk Interfluve (Resursy poverkhnostnykh vod r. Ob i Ob'-Irtyskogo mezhdurech'ya),
W72-02065 4A

VREUGDENHIL, C. B.
Discontinuities in Stratified Flows,
W72-01723 2E

WATTE, E. V.
Field Evaluation of Heavy-Walled Pressure Vessels Using Acoustic Emission Analysis,
W72-01776 8G

WALKER, D. J.
Modification of Carcase Characteristics in Sheep Maintained on a Saline Water Regime,
W72-01958 3C

WALSH, M. A.
Gas-Phase Catalytic Oxidation of Phenol in Dilute Concentrations with Water Vapor,
W72-02050 5D

WARD, J. C.
Evaluation of Effect of Impoundment on Water Quality in Cheney Reservoir,
W72-01773 5F

WARNER, T. B.
Some Aspects of the Geochemistry of F, Fe and Mn in Coastal Waters and in Fresh-Water Springs on the Southeast Coast of Hawaii,
W72-01998 2K

WARREN, CHARLES E.
Biological Indices of Water Pollution with Special Reference to Fish Population,
W72-01791 5C

WARRICK, A. W.
Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals,
W72-01781 2F

Time in Transit of Water Moving Vertically for Ground Water Recharge,
W72-01750 2G

WARSH, C. E.
Water Exchange at the Mouth of the Gulf of California,
W72-02041 2E

WARSH, K. L.
Water Exchange at the Mouth of the Gulf of California,
W72-02041 2E

WASHINGTON, D. R.
Kinetics of the Steady State Bacterial Culture IV. Transfer Rates,
W72-01865 5D

WATTS, M. S. W.
Ecological Health and Quality of Life, Now and Forevermore,
W72-02252 6G

WEAVER, C. R.
Snow in Ohio,
W72-02027 2C

WEBB, D. J.
Effects of Nitrogen Fertilizer, Plant Population and Irrigation on Sugar Beet: I. Yields,

W72-01961 3F

WEEDFALL, R. O.
Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia,
W72-02025 2B

WEEKS, W. F.
Effect of Growth Parameters on Substructure Spacing in NaCl Ice Crystals,
W72-02092 2C

WEERTMAN, J.
Shear Stress at the Base of a Rigidly Cirque Glacier,
W72-01707 2C

WEGLENSKA, TERESA
The Effect of Sampling Frequency and the Method of Assessment on the Production Values Obtained for Several Zooplankton Species,
W72-01933 2I

WEHUNT, E. P. JR
A Methodology Study to Develop Evaluation Criteria for Wild and Scenic Rivers: Landowner Perception of Recreationist Associated Conflicts in the Salmon-Little Salmon River Corridor of Idaho,
W72-01746 6B

WEISS, L. E.
Coastal Zone Management--The Tidelands: Legislative Apathy Vs. Judicial Concern,
W72-02153 6E

WELANDER, P.
Some Exact Solutions to the Equations Describing an Ideal-Fluid Thermocline,
W72-02032 2G

WENDELL, C.
Low Cost Storm Drainage With Paved Channels,
W72-01880 4A

WENGER, DENNIS
Environment Crises,
W72-01694 6B

WERNER, EARL E.
An Experimental Approach to the Production Dynamics and Structure of Freshwater Animal Communities,
W72-02192 2I

WESNER, G. M.
Reclaimed Waste Water for Groundwater Recharge,
W72-02006 5D

WESTHOFF, V.
Some Data on the Growing Site of Hypericum Canadense L. (In Dutch),
W72-01926 2I

WESTMAN, J. R.
Oxygen Requirements of Some Marine and Anadromous Fishes, with Particular Reference to Problems of Measurement,
W72-01875 5C

WETZEL, R. G.
Phytoplanktonic Nitrogen as an Index of Cultural Eutrophication,
W72-01780 5C

WHIPPLE, W. JR
1970 Literature Review, Administration: Economics,

W72-02140 6B

WILCOX, R. M.
Microwave Radiometric Detection of Oil Slicks,
W72-02024 5A

WILDE, D. J.
The Simulation and Optimization of a Single Effect Multi-Stage Flash Desalination Plant,
W72-02131 6A

WILDER, D. G.
Gasoline Pollution of a Ground-Water Reservoir - A Case History,
W72-02079 5B

WILKINSS, P. E.
Some Aspects of the Geochemistry of F, Fe and Mn in Coastal Waters and in Fresh-Water Springs on the Southeast Coast of Hawaii,
W72-01998 2K

WILLIAMS, D. E.
Gasoline Pollution of a Ground-Water Reservoir - A Case History,
W72-02079 5B

WILLIAMS, D. P.
Microwave Radiometric Detection of Oil Slicks,
W72-02024 5A

WILLIAMS, J. D. H.
Characterization of Inorganic Phosphate in Noncalcareous Lake Sediments,
W72-02113 2H

WILLIAMS, R.
Nonlinear Dupuit Equations for the Phreatic Surface of a Semi-Infinite Aquifer,
W72-02004 2F

WILLIS, W. O.
Soil Water Extraction by N-Fertilized Spring Wheat,
W72-02165 3F

WILSON, G. L.
Some Factors Responsible for Varying Effectiveness of Stomatal Closing Antitranspirants,
W72-01774 3F

WILSON, L.
Drainage Density, Length Ratios, and Lithology in a Glaciated Area of Southern Connecticut,
W72-01717 2J

WILSON, L. G.
Management of Artificial Recharge Wells for Groundwater Quality Control,
W72-02228 5G

WINDOM, HERBERT L.
Diurnal Variations in the Chemical Characteristics of the Ogeechee Estuary in Georgia,
W72-01934 2L

WINTERBOURN, M. J.
Population Studies on the New Zeland Freshwater Gastropod, *Potamopyrgus antipodarum* (Gray),
W72-01950 2I

WISNIEWSKI, THEODORE F.
The Chemistry and Biology of Milk Waste Disposal,
W72-01816 5D

WONG, K. M.
Plutonium-239 in and Over the Atlantic Ocean,

AUTHOR INDEX

WORLEY, D. P.

W72-02083 5B

WORLEY, D. P.

Economic Evaluation of Some Watershed Management Alternatives on Forest Land in West Virginia,
W72-02146 4A

WRIGHT, J. J.

The Occurrence of Thermal Ground-Water in the Basin and Range Province of Arizona,
W72-02229 2F

WRIGHT, L. N.

Drought Influence on Germination and Seedling Emergence,
W72-01739 3F

YADAV, J. S. P.

Soil Suitability for Eucalyptus Hybrid (Synonym E. Tereticornis or Mysore Gum) Plantations in Tarat and Bhabar Region of Uttar Pradesh,
W72-01904 2G

YAKOVLEVA, L. V.

Soil Processes in Secondary Sod-podzolic Soils on the Shores of Rybinsk Reservoir Upon Their Underflooding, (In Russian),
W72-01944 2G

YAKOWITZ, S. J.

Statistical Inference on Streamflow Processes with Markovian Characteristics,
W72-01704 2E

YAMAMOTO, YASUSHI

Archobacter Luteus Nov. Sp. Isolated From Brewery Sewage,
W72-02182 5A

YANKAVICHYUTE, G. Y.

The Mineralization Activity of Bacterioplankton in Freshwater Ecosystems, (In Russian),
W72-01940 2I

YANKAVICHYUS, K. K.

The Mineralization Activity of Bacterioplankton in Freshwater Ecosystems, (In Russian),
W72-01940 2I

YASUNDA, H.

Improved Membranes for Reverse Osmosis,
W72-01833 3A

YU, SHAW L.

Aerator Performance in Natural Streams,
W72-01842 5G

YUSHCHAK, A. A.

Hydrologic Computational Methods for Marine Hydraulic Engineering Construction (Metody morskikh gidrologicheskikh raschetov dlya tseley

gidrotekhnicheskogo stroitel'stva),
W72-02094 2L

ZAKHAROV, V. P.

Long-Term Water Balance of the Irtysh River in Kazakhstan (Perspektivnyy vodokhozyaystvennyy balans r. Irtysha v Kazakhstanskoy chasti),
W72-02066 4A

ZALIBEROVA, MARICA

Agrostidetum Stoloniferae (Moor 1958) Oberd. et th. Muller 1961 on the Littoral of the Poprad River (In Czech),
W72-02206 2I

ZAPRYAGAEVA, V. I.

Establishment of Anti-Erosion Plantations in the Mountain Regions of Tadzhikistan (In Russian),
W72-01899 4A

ZHIDIKOV, A. P.

Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniya vesennego stoka i yeye realizatsiya dlya prognoza gidrografa),
W72-02096 2E

ZWOLINSKI, M. J.

Effects of Fire on Water Infiltration Rates in a Ponderosa Pine Stand,
W72-02219 2G

ORGANIZATIONAL INDEX

ABERDEEN UNIV. (SCOTLAND). DEPT. OF GEOGRAPHY. Evidence of Cirque Glaciation in the Falkland Islands, W72-01713	2J	W72-02226	5D	W72-02059	2J
ACADEMY OF NATURAL SCIENCES, PHILADELPHIA, PA. DEPT. OF LIMNOLOGY. Aquatic Organisms as an Aid in Solving Waste Disposal Problems, W72-01801	5C	AGRICULTURAL RESEARCH SERVICE, TUCSON, ARIZ. PLANT SCIENCE RESEARCH DIV., AND ARIZONA UNIV., TUCSON. DEPT. OF AGRONOMY. Drought Influence on Germination and Seedling Emergence, W72-01739	3F	AMERICAN STANDARD INC., NEW BRUNSWICK, N. J. The Design, Fabrication and Testing of a 1000 Gallon Per Day Tubular Reverse Osmosis Pilot Plant, W72-02045	3A
AEROJET GENERAL CORP., EL MONTE, CALIF. Development of New and Improved Cellulose Ester Reverse Osmosis Membranes, W72-02049	3A	AGRICULTURE COLL., KANPUR (INDIA). Uptake of Nitrogen and Phosphorus by Paddy Under Water-Logged Condition, W72-02172	3F	AMERICAN WATER RESOURCES ASSOCIATION. Hydrology and Water Resources in Arizona and the Southwest, Volume I. W72-02212	4A
AEROJET-GENERAL CORP., EL MONTE, CALIF. MICROWAVE DIV. Microwave Radiometric Detection of Oil Slicks, W72-02024	5A	Performance of Mexican Dwarf Wheats, W72-02174	3F	AMERICAN WATER WORKS ASSOCIATION, NEW YORK. WATER QUALITY DIV. COMMITTEE ON NUTRIENTS IN WATER. Chemistry of Nitrogen and Phosphorus in Water. W72-01867	5C
AFRICAN EXPLOSIVES AND CHEMICAL INDUSTRIES LTD., JOHANNESBURG (SOUTH AFRICA). Disposal of Nitrogenous Liquid Effluent From Modderfontein Dynamite Factory, W72-01866	5D	AKADEMIYA NAUK KAZAKHSKOI SSR, ALMA-ATA. Long-Term Water Balance of the Irtysh River in Kazakhstan (Perspektivnyy vodokhozyaystvennyy balans r. Irtysha v Kazakhstanskoy chasti), W72-02066	4A	AMICON CORP., CAMBRIDGE, MASS. Membranes for Desalination by Reverse Osmosis, W72-02046	3A
AGRICULTURAL EXPERIMENT STATION, GARDEN CITY, KANS. SOIL FERTILITY RESEARCH. Residual Mineral N Accumulation in Soil and its Utilization by Irrigated Corn (Zea Mays L.), W72-02167	3F	AKADEMIYA NAUK LITOVSKOI SSR, VILNIUS. INST. OF BOTANY. The Mineralization Activity of Bacterioplankton in Freshwater Ecosystems, (In Russian), W72-01940	2I	AMICON CORP., LEXINGTON, MASS. Final Report on Control of Concentration Polarization in Reverse Osmosis Desalination of Water, W72-02107	3A
AGRICULTURAL RESEARCH INST., REYKJAVIK (ICELAND). Range Resources of Iceland, W72-02181	3F	AKADEMIYA NAUK URSR, KIEV. INSTYTUT HIDROBIOLOGII. Chemical Composition of Higher Water Vegetation of the Kiev Reservoir (In Russian), W72-01929	2K	ARIZONA AGRICULTURAL EXPERIMENT STATION, TUCSON. Sugar Beets in Arizona, W72-01742	3F
AGRICULTURAL RESEARCH, PHOENIX, ARIZ. WATER CONSERVATION LAB. Field Measurements of Soil-Water Content and Soil-Water Pressure, W72-02222	2G	AKADEMIYA NAUK USSR, LVOV. INST. OF BOTANY. Bluegreen Algae of the Crimean Mineralized Reservoirs (In Ukrainian), W72-02183	2H	ARIZONA COOPERATIVE FISHERY UNIT., TUCSON. Soluble Carbohydrates as a Factor Influencing Gross Primary Productivity and Bacterial Populations in Lakes, W72-01938	2H
AGRICULTURAL RESEARCH SERVICE, FORT COLLINS, COLO. SOIL AND WATER CONSERVATION RESEARCH DIV. Effective Drought Control for Successful Dryland Agriculture, W72-01759	3F	ALABAMA GEOLOGICAL SURVEY, UNIVERSITY. Subsurface Disposal of Liquid Industrial Wastes in Alabama-A Current status Report, W72-02075	5E	ARIZONA STATE UNIV., TEMPE. Use and Abuse of Southwestern Rivers. Historic Man--The Anglo, W72-02238	4A
AGRICULTURAL RESEARCH SERVICE, MANDAN, N. D. SOIL AND WATER CONSERVATION RESEARCH DIV. Soil Water Extraction by N-Fertilized Spring Wheat, W72-02165	3F	ALL-UNION DESIGNING, SURVEYING, AND SCIENTIFIC RESEARCH INST. HYDROPROJECT, MOSCOW (USSR). Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye ispol'zovaniye vodnykh resursov basseyna r. Obi), W72-02062	4A	ARIZONA STATE UNIV., TEMPE. DEPT. OF GEOLOGY. Terraces and Pediment-Terraces in the Southwest: An Interpretation, W72-01719	2J
AGRICULTURAL RESEARCH SERVICE, MORGANTOWN, W. VA. Effect of Two Growth-Regulating Chemicals on Yield and Water Use of Three Perennial Grasses, W72-01908	3F	ALLAHABAD UNIV. (INDIA). DEPT. OF CHEMISTRY. Osmotic Pressure in Relation to the Growth of Barley Plants in Saline and Alkali Soils, W72-02173	3F	ARIZONA UNIV., TUCSON. Measurement and Analysis of Unsaturated Flow and Groundwater Surface Profiles Related to Recharge and Withdrawals, W72-01781	2F
AGRICULTURAL RESEARCH SERVICE, PHOENIX, ARIZ. WATER CONSERVATION LAB. Seasonal Effects on Soil Drying After Irrigation, W72-02217	2D	AMERICAN FOUNDATION, INC., DRAGOON, ARIZ. Use and Abuse of Southwestern Rivers. The Pueblo Dweller, W72-02236	3F	Effects of Fire on Water Infiltration Rates in a Ponderosa Pine Stand, W72-02219	2G
Renovating Sewage Effluent by Ground-Water Recharge,		AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK. TASK COMMITTEE ON PREPARATION OF SEDIMENTATION MANUAL. Sediment Transportation Mechanics: Fundamentals of Sediment Transportation.		ARIZONA UNIV., TUCSON. DEPT. OF AGRICULTURAL CHEMISTRY AND SOILS. Time in Transit of Water Moving Vertically for Ground Water Recharge, W72-01750	2G
				ARIZONA UNIV., TUCSON. DEPT. OF GEOSCIENCES. The Occurrence of Thermal Ground-Water in the Basin and Range Province of Arizona,	

ORGANIZATIONAL INDEX

ARIZONA UNIV., TUCSON, DEPT. OF HORTICULTURE.

W72-02229	2F	W72-01702	2C	W72-01994
ARIZONA UNIV., TUCSON. DEPT. OF HORTICULTURE. Mulching Techniques for Arid Lands Vegetable Production, W72-02221		ARIZONA UNIV., TUSCON. DEPT. OF MATHEMATICS. Statistical Inference on Streamflow Processes with Markovian Characteristics, W72-01704		BATTELLE NORTHWEST, RICHLAND, WASH. ENVIRONMENTAL AND LIFE SCIENCES DIV.; AND WASHINGTON STATE UNIV., PULLMAN. DEPT. OF AGRONOMY. Psychrometric Determination of Water Potential of Desert Plants, W72-01761
ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES. Conditional Streamflow Probability Distributions, W72-02223	3F	ARIZONA UNIV., TUSCON. DEPT. OF WATERSHED MANAGEMENT. Hydrologic Characterization of Forested Watersheds in Arizona, W72-01703	2E	21 BEDFORD INST., DARTMOUTH (NOVA SCOTIA). ATLANTIC OCEANOGRAPHIC LAB. Distribution of Suspended Oil Particles Following the Grounding of the Tanker Arrow, W72-02036
A Stochastic Analysis of Flows on Rillito Creek, W72-02224	6A	ARMY COASTAL ENGINEERING RESEARCH CENTER, WASHINGTON, D.C. A Class of Probability Models for Littoral Drift, W72-02121	2A	5B BENGAL ENGINEERING COLL., HOWRAH (INDIA). Numerical Solution of Filtration Equations, W72-01841
Optimal Utilization of Playa Lake Water in Irrigation, W72-02231	2E	ARMY ENGINEER DISTRICT, LOS ANGELES, CALIF. 'S' Street Channel Improvements, Needles, San Bernardino County, California, Environmental Statement (Environmental statement). W72-01828	6A	5D BLACK AND VEATCH INTERNATIONAL, KANSAS CITY, MO. Preliminary Study of the Development of Water Resources of the Humacao Sub-region, Puerto Rico. W72-01829
ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES; AND TEXAS TECH UNIV., LUBBOCK. DEPT. OF AGRICULTURAL ENGINEERING. Recharging the Ogallala Formation Using Shallow Holes, W72-02227	4B	ARMY ENGINEER DISTRICT, NEW YORK. Navigation Project, Newark Bay, Hackensack and Passaic Rivers, New Jersey, (Final Environmental Statement). W72-01826	8A	6D BRISTOL UNIV. (ENGLAND). DEPT. OF BOTANY. The Effects of Stratification on Phytoplanktonic Diatoms in a Small Body of Water, W72-01919
ARIZONA UNIV., TUCSON. DEPT. OF SYSTEMS ENGINEERING. Collective Utility: A Systems Approach for the Utilization of Water Resources, W72-02232	4B	ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISS. Model Studies of Outfall Systems for Desalination Plants (Part I - Flume Study), W72-01838	8A	BRISTOL UNIV. (ENGLAND). DEPT. OF BOTANY. Some Physico-chemical Investigations of Stratification in Abbot's Pool, Somerset: The Distribution of some Dissolved Substances, W72-01937
Comparison of Water Pricing Structures from a Collective Utility Viewpoint, W72-02233	6C	Survey of Applications of Epoxy Resins for Civil Works Projects, W72-02120	8G	2H BROOM'S BARN EXPERIMENT STATION, BURY ST. EDMONDS (ENGLAND). Effects of Nitrogen Fertilizer, Plant Population and Irrigation on Sugar Beet: III. Water Consumption, W72-01959
ARIZONA UNIV., TUCSON. DEPT. OF WATERSHED MANAGEMENT. Progress in Developing Forest Management Guidelines for Increasing Snowpack Water Yields, W72-02230	4A	ARMY ENGINEER WATERWAYS EXPERIMENTATION STATION, VICCSBURG, MISS. Effects of Temporary and Permanent Blankets on Tides and Currents in East River, Hydraulic Model Investigation, W72-01827	8A	3F BROOM'S BARN EXPERIMENT STATION, BURY ST. EDMUNDS (ENGLAND). Effects of Nitrogen Fertilizer, Plant Production and Irrigation on Sugar Beet: II. Nutrient Concentration and Uptake, W72-01960
ARIZONA UNIV., TUCSON. LAB. OF TREE-RING RESEARCH. Augmenting Annual Runoff Records Using Tree-Ring Data, W72-02213	2E	ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL (ENGLAND). Radioactive Wastes-Their Treatment and Disposal, W72-01871	5D	3F BROOM'S BARN EXPERIMENT STATION, BURY ST. EDMUNDS (ENGLAND). Effects of Nitrogen Fertilizer, Plant Population and Irrigation on Sugar Beet: I. Yields, W72-01961
Tree-Ring Dating of Colorado River Driftwood in the Grand Canyon, W72-02234	7B	AUSTRALIAN NATIONAL UNIV., CANBERRA. RESEARCH SCHOOL OF BIOLOGICAL SCIENCES. Pattern in Desert Perennials, W72-01760	2I	BUILDING RESEARCH STATION, WATFORD (ENGLAND). Rockfill, W72-01765
ARIZONA UNIV., TUCSON. OFFICE OF ARID LANDS STUDIES. Nitrogen Balance for a 23 Square Mile Minnesota Watershed, W72-02216	2K	BAGHDAD UNIV. (IRAQ). COLL. OF SCIENCES. Autecology of Common Egyptian Fagonia Species, W72-01922	2I	8D BULGARIAN ACADEMY OF SCIENCES, SOFIA. INST. FOR HYDROLOGY AND METEOROLOGY. Determination of the Loop Discharge Rating Curve for Flood Wave Propagation, W72-01724
ARIZONA UNIV., TUCSON. WATER RESOURCES RESEARCH CENTER. Blue-Green Algal Effects on Some Hydrologic Processes at the Soil Surface, W72-02218	2G	Contribution to the Autecology of Urginea Maritima in Egypt, W72-01923	2I	2E BULGARIAN ACADEMY OF SCIENCES, SOFIA. INST. OF GENETICS AND SELECTION OF PLANTS. Soil Moisture as Affecting Certain Physiologically-Biochemical Processes in Winter Wheat During the Autumn-Winter Period. (In Russian)
The Use of a Realistic Rainfall Simulator to Determine Relative Infiltration Rates of Contributing Watersheds to the Lower Gila Below Painted Rock Dam, W72-02220	2G	BATTELLE MEMORIAL INST., COLUMBUS, OHIO. ANALYTICAL METHODOLOGY INFORMATION CENTER. Design and Operation of an Information Center on Analytical Methodology		
Management of Artificial Recharge Wells for Groundwater Quality Control, W72-02228	5G			
ARIZONA UNIV., TUSCON. Hydrologic Characterization of Forested Watersheds in Arizona				

ORGANIZATIONAL INDEX
COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, N.H.

W72-02168	3F	W72-01708	2C	W72-02163	21
BUNDESGESUNDHEITSAMT, BERLIN (WEST GERMANY), INSTITUT FUER WASSER-, BODEN-, UND LUFTHYGIENE. Biological Study of Rainwater Gathering Ponds in Berlin, W72-01939	21	Determination of the Three-Dimensional Velocity Field in a Glacier, W72-02147	2C	CENTRAL SOIL SALINITY RESEARCH INST., KARNAL (INDIA). Soil Suitability for Eucalyptus Hybrid (Synonym E. Tereticornis or Mysore Gum) Plantations in Tarat and Bhabar Region of Uttar Pradesh, W72-01904	2G
BUREAU OF FISHERIES, WASHINGTON, D. C. INTERIOR FISHERIES INVESTIGATIONS; AND MISSOURI UNIV., COLUMBIA WASHINGTON, D.C. DEPT. OF PHYSIOLOGY. Detection and Measurement of Stream Pollution, W72-01804	5C	CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, SACRAMENTO. • Reclaimed Waste Water for Groundwater Recharge, W72-02006	5D	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, GRENOBLE (FRANCE). LABORATOIRE DE GLACIOLOGIE. Permeability, Brine Content and Temperature of Temperate Ice, W72-01706	2C
BUREAU OF MINES, BARTLESVILLE, OKLA. PETROLEUM RESEARCH CENTER. Iodine and Algae in Sedimentary Rocks Associated with Iodine-Rich Brines, W72-02073	2K	CALIFORNIA UNIV., DAVIS. DEPT. OF AGRONOMY AND RANGE SCIENCE. Drought Influence on Physiological Processes and Subsequent Growth, W72-01758	3F	Corrective Terms in the Glaciological Balance, W72-01715	2C
BUREAU OF RECLAMATION, DENVER, COLO. Synthetic Rubber Canal Lining, Laboratory and Field Investigations of Synthetic Rubber Sheeting for Canal Lining - Open and Closed Conduit Systems Program, W72-01763	8G	CALIFORNIA UNIV., DAVIS. DEPT. OF FOOD SCIENCE AND TECHNOLOGY. Sensory Examination of Mineralized, Chlorinated Waters, W72-01868	5F	CESKOSLOVENSKA AKADEMIE VED, BRATISLAVA. BOTANICKY USTAV, SLOVAK ACADEMY OF SCIENCES, BRATISLAVA (CZECHOSLOVAKIA). BOTANICAL INST. Agrostidetum Stoloniferae (Moor 1958) Oberd. et th. Muller 1961 on the Littoral of the Poprad River (In Czech.). W72-02206	21
A Decade of EHV Transmission in the Soviet Union--An Annotated Bibliography, W72-01766	8C	CALIFORNIA UNIV., DAVIS. DEPT. OF WATER SCIENCE. Determination of Nonlinear Functional Response Functions in Rainfall-Runoff Processes, W72-02116	2A	CESKOSLOVENSKA AKADEMIE VED, BRNO. USTAV PRO VYZKUM OBRATLOVU. Natural Productivity of Wildfowl on the Namestské Rubníky Ponds (Czechoslovakia), W72-01912	21
Deformation Moduli Determined by Joint-Shear Index and Shear Catalog, W72-01769	8E	Perennial Irrigated Pastures: I. Plant, Soil Water, and Animal Responses Under Rotational and Continuous Grazing, W72-02180	3F	CESKOSLOVENSKA AKADEMIE VED, PRAGUE. HYDROBIOLOGICKA LAB. List of Freshwater Crustaceans of Cuba and Their Zoogeographical Relationships, W72-01887	21
A Series of Reinsertion Transient Voltages for Series Capacitors on USBR Glen Canyon - Flagstaff 345 KV Lines, W72-01775	8C	CALIFORNIA UNIV., SAN DIEGO, LA JOLLA. INST. OF MARINE RESEARCH. A Permanent record of Plankton Samples Using Holography, W72-02202	2I	CLARKSON COLL. OF TECHNOLOGY, POTSDAM, N.Y. DEPT. OF CIVIL ENGINEERING. Theoretical Evaluation of Filter Modeling Experiments, W72-01859	5E
BUREAU OF RECLAMATION, WASHINGTON, D. C. Owner-Engineer-Contractor Relationships in Tunneling, W72-01764	8H	CAMP, DRESSER AND MCKEE, BOSTON, MASS. Model for Flow Augmentation Analysis-An Overview, W72-01874	5G	CLEMSON UNIV., S. C. Economics and Politics in Water Pollution Control, W72-02135	5G
C. S. I. R. O., DIV. NUTR. BIOCHEM., ADELAIDE, S. AUST. COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, ADELAIDE (AUSTRALIA). DIV. OF NUTRITIONAL BIOCHEMISTRY. Modification of Carcass Characteristics in Sheep Maintained on a Saline Water Regime, W72-01958	3C	CAMP, DRESSER AND MCKEE, INC., BOSTON, MASS. Inventory and Problem Delineation, Phase I Report, Regional Water Supply and Wastewater Disposal Study. W72-01830	6D	CLEMSON UNIV., S.C. DEPT. OF AGRICULTURAL ECONOMICS. Empirical Study of Economic-Ecologic Linkages in a Coastal Area, W72-02126	6A
CALCUTTA UNIV. (INDIA). COLL. OF AGRICULTURE. Studies in Water Relations of Rice: V. Effect of Varying Water Regimes on the Growth of Main Shoot in Indica Rice, W72-02170	3F	CANTERBURY UNIV., CHRISTCHURCH (NEW ZEALAND). A Method of In Situ Stiffness Measure, W72-01770	8D	COASTAL BEND REGIONAL PLANNING COMMISSION, CORPUS CHRISTI, TEX. OSO Creek Technical Assistance Study: Preliminary Study on the Problems and Opportunities for Development of OSO Creek and OSO Bay. W72-02028	6B
CALGARY UNIV. (ALBERTA). DEPT. OF BOTANY. The Incidence and Intensity of Predation on Lake-dwelling Tricladids in the Field, W72-01948	2H	CAPETOWN UNIV. (SOUTH AFRICA). DEPT. OF ZOOLOGY. The Ecology of South African Estuaries: X. St. Lucia: A Second Report, W72-02204	2L	COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, N. H. A Hot-Wire Engine to Produce Periodic Grooves on an Ice Surface, W72-01714	2C
CALIFORNIA INST. OF TECH., PASADENA. A New Bore-Hole Inclinometer, W72-02001	2C	CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA). Studies on Plant-Water Relationships. V. Influence of Soil Moisture on Plant Performance and Nitrogen Status of the Shoot Tissue,		COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, N.H. Creep of Ice Under Low Stress,	
CALIFORNIA INST. OF TECH., PASADENA. DIV. OF GEOLOGICAL SCIENCES. Flow in a Transverse Section of Athabasca Glacier, Alberta, Canada,					

ORGANIZATIONAL INDEX

COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, HANOVER,

W72-02091	2C	W72-02138	6E	W72-01822	5F
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, HANOVER, N.H.		DACCA UNIV. (PAKISTAN). DEPT. OF BOTANY.		DEPARTMENT OF PRIMARY INDUSTRIES, SOUTH JOHNSTON (AUSTRALIA). RESEARCH STATION.	
Effect of Growth Parameters on Substructure Spacing in NaCl Ice Crystals, W72-02092	2C	Effects of Induced Drought on Rice Plants, W72-01963	3F	Fertility Studies of Pasture Soils in the Wet Tropical Coast of Queensland: I. Soil-Vegetation Classification Units, W72-01737	3F
COLORADO STATE UNIV., FORT COLLINS.		DANISH ATOMIC ENERGY COMMISSION, RISOE. RESEARCH ESTABLISHMENT.		DEPARTMENT OF PRIMARY INDUSTRIES, SOUTH JOHNSTONE (AUSTRALIA). RESEARCH STATION.	
Evaluation of Effect of Impoundment on Water Quality in Cheney Reservoir, W72-01773	5F	Radioecological Investigations of Plutonium in an Arctic Marine Environment, W72-01884	5B	Fertility Studies of Pasture Soils in the Wet Tropical Coast of Queensland: II. Granitic Soils, W72-01767	3F
COLORADO STATE UNIV., FORT COLLINS. DEPT. OF ECONOMICS.		DARTMOUTH COLL., HANOVER, N. H. DEPT. OF EARTH SCIENCES.		DEPARTMENT OF PRIMARY INDUSTRIES, SOUTH JOHNSTONE (AUSTRALIA). RESEARCH STATION.	
Secondary Economic Effects of Irrigation on the Colorado High Plains, W72-02136	6B	Basement Ice, Ward Hunt Ice Shelf, Ellesmere Island, Canada, W72-01710	2C	Fertility Studies of Pasture Soils in the Wet Tropical Coast of Queensland: III. Granitic Soils, W72-01767	3F
COLORADO UNIV., BOULDER. DEPT. OF GEOLOGICAL SCIENCES.		DELAWARE UNIV., NEWARK. DEPT. OF CHEMICAL ENGINEERING.		DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, AUCKLAND (NEW ZEALAND). BOTANY DIV.	
Chemical Weathering of the Biscayne Aquifer, Dade County, Florida, W72-01731	2F	Gas-Phase Catalytic Oxidation of Phenol in Dilute Concentrations with Water Vapor, W72-02050	5D	Manawatu Sand Dune Vegetation, W72-01928	21
COLORADO UNIV., BOULDER. INST. OF ARCTIC AND ALPINE RESEARCH.		DELAWARE UNIV., NEWARK, N. J. DEPT. OF CIVIL ENGINEERING.		DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, PLAMERSTON NORTH (NEW ZEALAND). PLANT PHYSIOLOGY DIV.	
Permafrost Occurrence in the Front Range, Colorado Rocky Mountains, U.S.A., W72-01712	2C	Mathematical Foundations for Design: Civil Engineering Systems, W72-02127	6A	Lysimeter and Interception Studies in Narrow-leaved Snow Tussock Grassland, W72-01931	2B
COLUMBIA UNIV., NEW YORK. DEPT. OF GEOLOGY.		DENVER RESEARCH INST., COLO.		DEPT. OF HEALTH, EDUCATION AND WELFARE, CINCINNATI, OHIO. BUREAU OF SOLID WASTE MANAGEMENT.	
Drainage Density, Length Ratios, and Lithology in a Glaciated Area of Southern Connecticut, W72-01717	2J	Constant Total Pressure Evaporation Process with Heat Reuse by a Built-in Engine, W72-01834	3A	Virus Inactivation During Phosphate Precipitation, W72-01852	5D
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, DENILQUIN (AUSTRALIA). DIV. OF PLANT INDUSTRY.		DEPARTMENT OF AGRICULTURE OF NEW SOUTH WALES, LEETON (AUSTRALIA).		DETROIT UNIV., MICH. DEPT. OF BIOLOGY.	
Response by Irrigated Grain Sorghum to Broadcast Gypsum and Phosphorous on Heavy Clay Soil, W72-02117	3F	Water Use by Maize at Three Plant Densities, W72-01968	3F	Natural Relationships of Indicator and Pathogenic Bacteria in Stream Waters, W72-01996	5B
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, DENILQUIN (AUSTRALIA). DIV. OF PLANT INDUSTRY.		DEPARTMENT OF AGRICULTURE, SOUTH PERTH (AUSTRALIA).		DIRECTOR OF PUBLIC WORKS, ROCKFORD, ILL.	
Assessment of Summer Irrigated Pastures to Supplement Sheep Grazing Irrigated Annual Pastures, W72-01957	3F	The Effect of Burr Burial on the Seed of Some Early Maturing Subterranean Clover Cultivars, W72-01736	3F	Low Cost Storm Drainage With Paved Channels, W72-01880	4A
COPENHAGEN UNIV., HILLEROD (DENMARK). FRESHWATER-BIOLOGICAL LAB.		DEPARTMENT OF AGRICULTURE, SWIFT CURRENT (SASKATCHEWAN). RESEARCH STATION.		DORR-OLIVER, INC., STAMFORD, CONN.	
Measurements of Primary Production Dark Fixation and Vertical Distribution of the Microbenthic Algae in the Oresund, W72-02205	2L	Can We Breed for Drought Resistance, W72-01757	3F	Advance Wastewater Treatment, W72-01879	5D
CORNELL UNIV., ITHACA, N. Y.		DEPARTMENT OF AGRICULTURE, URBANA, ILL.		DOW CHEMICAL CO., MIDLAND, MICH. BIOCHEMICAL AND CHEMICAL RESEARCH LABS.	
Outdoor Recreation in New York State: Projections of Demand, Economic Value, and Pricing Effects for the Period 1970-1985, W72-02134	6B	Modification of a 360-Degree Antenna Rotor for Continuous Stepped Rotation, W72-01884	3F	The Biochemical Aspects of Aerobic Bacterial Growth, W72-01870	5F
CORPS OF ENGINEERS, DAVIS, CALIF. HYDROLOGIC ENGINEERING CENTER.		DEPARTMENT OF AGRICULTURE, WESLACO, TEX.		DU PONT DE NEMOURS (E.I.) AND CO., DELAWARE, MD.	
Digital Simulation of an Existing Water Resources System, W72-02132	6A	Water and Air Changes in Grapefruit, Corn, and Cotton Leaves with Maturation, W72-01772	3F	A Welter of Ideas--A Modicum of Coordination, W72-02151	5G
CORPS OF ENGINEERS, WASHINGTON, D. C.		DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA (ONTARIO).		DUNDEE UNIV., NEWPORT-ON-TAY (SCOTLAND). TAY ESTUARY RESEARCH CENTER.	
Dams and Dikes Across Waterways.		The Possible Future Behaviour of Berendon Glacier, Canada - A Further Study, W72-01709	2C	Channel Stability in the Estuary: Controls by Bedrock and Unconsolidated Post-Glacial Sediment, W72-01721	2L
		DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, WASHINGTON, D.C.		EDINBURGH UNIV. (SCOTLAND). DEPT. OF FORESTRY AND NATURAL RESOURCES.	
		ASSISTANT SECRETARY FOR HOUSING PRODUCTION AND MORTGAGE CREDIT.		Pattern and Seasonal Variability in the Environment of a Scots Pine Forest Soil,	
		Minimum Design Standards for Community Water Supply Systems (Existing standard--FHA 4517.1) (Draft environmental statement).			

ORGANIZATIONAL INDEX

GEOLOGICAL SURVEY, TALLAHASSEE, FLA.

W72-01906	2G	W72-02106	2J	W72-01975	3F
EDINBURGH UNIV. (SCOTLAND). SCHOOL OF MEDICINE. Recent Changes in the Movements of Adult Salmon <i>Salmo Salar</i> L. in the Tay-Tummel-Garry System, Scotland, W72-01917	8I	FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CORVALLIS, OREG. PACIFIC NORTHWEST LAB. The Barged Ocean Disposal of Wastes: A Review of Current Practice and Methods of Evaluation, -W72-01987	5C	FLORIDA UNIV., GAINSVILLE. WATER RESOURCES RESEARCH CENTER. Movement and Adsorption of Pesticides in Sterilized Soil Columns, W72-01697	5B
EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH. LAB. OF HYDRAULIC RESEARCH AND SOIL MECHANICS. Interaction of Rotating Elements of the Boundary Layer with Grains of a Bed; A Contribution to the Problem of the Threshold of Sediment Transportation, W72-01727	2J	FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, D.C. Biology of Water Pollution: A Collection of Selected Papers on Stream Pollution, Waste Water, and Water Treatment, W72-01786	5C	FOREST SERVICE, COLUMBUS, OHIO. NORTHEASTERN FOREST EXPERIMENT STATION; AND FOREST SERVICE, PARSONS, WEST VA. NORTHEASTERN FOREST EXPERIMENT STATION. Economic Evaluation of Some Watershed Management Alternatives on Forest Land in West Virginia, W72-02146	4A
ENVIROGENICS CO., EL MONTE, CALIF. New and Improved Cellulose Ester Membranes, W72-02111	3A	FISH AND WILDLIFE SERVICE, KEARNEYVILLE, W. VA. Value of the Bottom Sampler in Demonstrating the Effects of Pollution on Fish-Food Organisms and Fish in the Shenandoah River, W72-01800	5C	FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND). Upstream Movements of Benthic Invertebrates in a Lake District Stream, W72-01936	2H
ENVIRONMENTAL DATA SERVICE, SILVER SPRING, MD. Estimating Corn Canopy Extreme Temperatures From Shelter Values, W72-01969	3F	FISHERIES RESEARCH BOARD OF CANADA, WINNIPEG (MANITOBA). FRESHWATER INST. The Distribution and Abundance of Sand Gobies, <i>Gobius Minutus</i> , in the Ythan Estuary, W72-01954	2L	FRESHWATER BIOLOGICAL ASSOCIATION, WAREHAM (ENGLAND). RIVER LAB. The Populations, Growth and Production of Fish in Four Small Streams in Southern England, W72-01913	2I
ENVIRONMENTAL DATA SERVICE, SILVER SPRING, MD. LAB. FOR ENVIRONMENTAL DATA RESEARCH. Chemical Integrating Thermometer for Water Temperature Measurement, W72-02013	2K	FLORIDA STATE UNIV., TALLAHASSE. DEPT. OF GEOLOGY. Uranium and Tritium as Natural Tracers in the Floridian Aquifer, W72-01696	4B	FRESHWATER BIOLOGICAL ASSOCIATION, WESTMORLAND (ENGLAND). Studies on Freshwater Bacteria: Effect of Medium Composition and Method on Estimates Bacterial Population, W72-01956	5C
ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OHIO. ANALYTICAL QUALITY CONTROL LAB. Characterization and Identification of Spilled Residual Fuel Oils by Gas Chromatography and Infrared Spectrophotometry, W72-02196	5A	FLORIDA STATE UNIV., TALLAHASSE. DEPT. OF OCEANOGRAPHY. Water Exchange at the Mouth of the Gulf of California, W72-02041	2E	GANNETT, FLEMING, CORDDRY AND CARPENTER, INC., HARRISBURG, PA. Inka Aeration at Hazleton, Pennsylvania, W72-01844	5D
ENVIRONMENTAL PROTECTION AGENCY, DULUTH, MINN. NATIONAL WATER QUALITY LAB. Temperature Requirements for Growth and Survival of Larval Ciscos (<i>Coregonus Arted II</i>), W72-01989	5C	FLORIDA UNIV., GAINSVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING. A Partial Checklist of Florida Fresh-Water Algae and Protozoa with Reference to McCloud and Cue Lakes, W72-01993	5A	GEOLOGICAL SURVEY, ANCHORAGE, ALASKA. Ground-Water Exploration, Beaver Creek Valley Near Kenai, Alaska, W72-02087	4B
ENVIRONMENTAL PROTECTION AGENCY, KANSAS CITY, MO. Water Quality Investigations, Souris River Basin, North Dakota - 1969. W72-01992	5B	FLORIDA UNIV., GAINSVILLE. DEPT. OF GEOGRAPHY. Against Monoculture, W72-01762	3F	GEOLOGICAL SURVEY, LAWRENCE, KANS. Test of the Stroebel Spring - A Supplementary Study of the Fort Carson Expansion Project, Civil Action No. 8920, Tract No. 202, El Paso County, Colorado, W72-02088	4B
ENVIRONMENTAL PROTECTION AGENCY, SEATTLE, WASH. REGION X. Nitrogen Supersaturation in the Columbia and Snake Rivers, W72-02159	5B	FLORIDA UNIV., GAINSVILLE. WATER RESOURCES RESEARCH CENTER. The Radiochromatographic Analysis of Fresh Water Resources, W72-01981	2K	GEOLOGICAL SURVEY, OAK PARK, ILL. Floods in Harvard Southwest Quadrangle, Northeastern Illinois, W72-02085	2E
ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, D.C. OFFICE OF WATER PROGRAMS. Control of Sediments Resulting from Highway Construction and Land Development, W72-02160	5B	FLORIDA UNIV., GAINSVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING. Eutrophication: Small Florida Lakes as Models to Study the Process, W72-01990	5B	GEOLOGICAL SURVEY OF INDIA, LUCKNOW. Refraction Seismic Investigation at Zemu Glacier, Sikkim, W72-02000	2C
ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, D.C. OFFICE OF WATER PROGRAMS. Control of Sediments Resulting from Highway Construction and Land Development, W72-02160	5B	FLORIDA UNIV., GAINSVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING. GAINESVILLE, FLORIDA, ENVIRONMENTAL ENGINEERING DEPARTMENT. Application of Mathematical Models to the Eutrophication Process, W72-01991	5B	GEOLOGICAL SURVEY, TALLAHASSEE, FLA. A Preliminary Evaluation of Hydrologic Conditions of the Lakeland Ridge Area of Polk County, Florida, W72-02086	4B
		FLORIDA UNIV., GAINSVILLE. INST. OF FOOD AND AGRICULTURAL SCIENCE. Nutritive Value of Fertilized Jaragua Grass (<i>Hyparrhenia Rufa</i> (Nees) Stapf.) in the Wet-Dry Pacific Region of Costa Rica,		Hydrologic Effects of Water Control and Management of Southeastern Florida,	

ORGANIZATIONAL INDEX

GEOLOGICAL SURVEY, TUCSON, ARIZ.: AND ARIZONA UNIV.,

W72-02090	4A	W72-02070	4A	W72-02200	2L
GEOLOGICAL SURVEY, TUCSON, ARIZ.; AND ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES. Uncertainties in Digital-Computer Modeling of Groundwater Basins, W72-02215	2F	GOTEBORG UNIV. (SWEDEN). INST. OF OCEANOGRAPHY. Some Exact Solutions to the Equations Describing an Ideal-Fluid Thermocline, W72-02032	2G	HOWARD UNIV., WASHINGTON, D.C. DEPT. OF CHEMICAL ENGINEERING. Dynamic Fluid Loss During Viscous Flow Through a Porous Vertical Slot, W72-02060	8B
GEOLOGICAL SURVEY, WASHINGTON, D.C. Geochemical Interpretations of Groundwater Flow Systems, W72-02007	2K	GREATER TAMPA UTILITY GROUP, FLA. STANDARDIZATION COMMITTEE. Standard Utilities Location. W72-01821	8A	HUMBOLDT-UNIVERSITAET ZUR BERLIN (EAST GERMANY). BIOLOGY SECTION. Relations Between the Age of Clone and the Course of Meiosis of <i>Sphaerocarpus</i> (In German). W72-01894	21
Ground Water for Irrigation in the Brooten-Belgrade Area, West-Central Minnesota, W72-02071	4B	GUELPH UNIV. (ONTARIO). DEPT. OF CROP SCIENCE. Effects of Leaf Orientation on Leaf Resistance to Water Vapor Diffusion in Soybean (Glycine Max L. Merr) Leaves, W72-02176	3F	HYDROCOMP INTERNATIONAL INC., PALO ALTO, CALIF. A Critical Review of Currently Available Hydrologic Models for Analysis of Urban Stormwater Runoff, W72-01978	2A
Salinity of Surface Water in the Lower Colorado River - Salton Sea Area, W72-02074	2K	GULF GENERAL ATOMIC INC., SAN DIEGO, CALIF. Large Reverse Osmosis System Technology and Module Development, W72-02047	3A	HYDROLOGICAL RESEARCH STATION, KILPAUK (INDIA). Limnological Studies on Parambikulam Aliyar-Project-I Aliyar Reservoir (Madras State), India, W72-02198	2H
GEORGIA INST. OF TECH., ATLANTA. ENGINEERING EXPERIMENT STATION. Optical Fourier Transform Technique for Measuring Sediment Concentration, W72-02158	2J	HANFORD ATOMIC PRODUCTS OPERATION, RICHLAND, WASH. Bioaccumulation of Radioisotopes Through Aquatic Food Chains, W72-01792	5B	IDAHO NUCLEAR CORP., IDAHO FALLS. Field Evaluation of Heavy-Walled Pressure Vessels Using Acoustic Emission Analysis, W72-01776	8G
GEORGIA UNIV., ATHENS. DEPT. OF ZOOLOGY. The Freshwater Fishes of Georgia, W72-01955	2I	HARSHBARGER AND ASSOCIATES, TUCSON, ARIZ. The Use of Chemical Hydrographs in Groundwater Quality Studies, W72-02225	5A	IDAHO UNIV., MOSCOW. DEPT. OF GEOGRAPHY. A Methodology Study to Develop Evaluation Criteria for Wild and Scenic Rivers: Landowner Perception of Recreationist Associated Conflicts in the Salmon-Little Salmon River Corridor of Idaho, W72-01746	6B
Observations of the Mud-Water Interface, W72-02052	2H	HAWAII UNIV., HONOLULU. DEPT. OF GEOGRAPHY. A Critique of the Concept of Growing Season, W72-02211	3F	ILLINOIS AGRICULTURAL EXPERIMENT STATION, URBANA. AGRONOMY DEPT. Trends in Practices and Production of Major Corn Belt Crops, W72-01941	3F
Organic-Inorganic Associations: Their Formation and Involvement in Nutrient Mobilization from the Sediments of Lakes, W72-02053	2H	HEALTH RESEARCH INST., MOSCOW (USSR). Characteristics in the Distribution of Proteus Group Bacteria in Sewage of Different Origin, (In Russian), W72-01889	5B	ILLINOIS GEOLOGICAL SURVEY, URBANA. Redistribution of Geothermal Heat by a Shallow Aquifer, W72-01720	2F
Oxidation-Reduction Determinations at The Mud-Water Interface, W72-02054	2H	HEBREW UNIV., REHOVOTH (ISRAEL). FACULTY OF AGRICULTURE. Changes in the Ratio Between Sugar Beet Evapotranspiration and Pan Evaporation During the Growing Season, W72-02179	3F	ILLINOIS STATE NATURAL HISTORY SURVEY, PEORIA. The Lake as a Microcosm, W72-01787	5C
GIDROMETEOROLOGICHESKII NAUCHNO-ISSLEDOVATELSKII TSENTR, LENINGRAD (USSR). Model of Spring Runoff Formation and its Application to Hydrograph Forecasting (Model' formirovaniya vesennego stoka i yeye realizatsiya dlya prognoza gidrografa), W72-02096	2E	HIGH PLAINS UNDERGROUND WATER CONSERVATION DISTRICT NO. 1, LUBBOCK, TEX. Annual Water Statement, 1970-1971. W72-01743	4B	ILLINOIS STATE WATER SURVEY, URBANA. HYDROLOGY SECTION. Feasibility of Recharging Treated Sewage Effluent into a Deep Sandstone Aquifer, W72-02077	5D
Agrometeorological Conditions in the Volga Region and the Effectiveness of Measures to Combat Unfavorable Hydrometeorological Phenomena (Agrometeorologicheskiye usloviya Povolzh'ya i effektivnost' meropriyatiy po bor'be s neblagopriyat'nymi gidrometeorologicheskimi yavleniyami), W72-02098	3F	Soil Moisture Survey, 1970-1971. W72-01744	2G	ILLINOIS STATE WATER SURVEY, URBANA. HYDROLOGY SECTION. Subsurface Storage and Disposal in Illinois, W72-02076	5E
GLASGOW UNIV. (SCOTLAND). DEPT. OF ZOOLOGY. The Age and Growth of Perch (<i>Perca fluviatilis</i> L.) in Two Scottish Lochs, W72-01916	2H	HITTMAN ASSOCIATES, INC., COLUMBIA, MD. Electrodialysis Desalting State-of-the-Art (1969). W72-02108	3A	ILLINOIS UNIV., URBANA. DEPT. OF AGRONOMY. Response of Alfalfa Varieties to Different Water Table Depths at Various Stages of Growth, W72-02162	3F
GOSUDARSTVENNYI GIDROLOGICHESKII INSTITUT, LENINGRAD (USSR). Surface-Water Resources of the Ob River and Ob-Irtysh Interflue (Resursy poverkhnostnykh vod r. Obi i Ob'-Irtyshskogo mezhdurech'ya), W72-02065	4A	HOKKAIDO UNIV. (JAPAN). FACULTY OF FISHERY. Amount of Pigments and Daily Production of Phytoplankton Occurring in Acidic Lake Toya (In Japanese), W72-02197	5C	ILLINOIS UNIV., URBANA. DEPT. OF CHEMISTRY; AND ILLINOIS WATER SURVEY, URBANA. Industrial Wastes as a Source of Tastes and Odors in Water Supplies,	
Investigations of Moisture Exchange in the Zone of Aeration in Irrigated Land (Issledovaniya vlagooobmena v zone aeratsii na oroshayemykh zemlyakh),		Observations on the Summer Population of Phytoplankton in Matoya Bay, Shima Peninsula, 1953 and 1954 (In Japanese),			

ORGANIZATIONAL INDEX

KIEL UNIV. (WEST GERMANY). INSTITUT FUER MEERESKUNDE.

W72-01815	5C	W72-01949	2I	W72-01909	2I
ILLINOIS UNIV., URBANA. DEPT. OF CIVIL AND MECHANICAL ENGINEERING. Viability of Long-Stored Airborne Bacterial Aerosols, W72-01882	5D	INSTITUTE OF HYDROLOGY, WALLINGFORD (ENGLAND). Objectives and Methods of Data Processing and Analysis in the Water Treatment Context, W72-02128	6A	IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH. Two Investigations of River Ice: Part I and Part 2, W72-02056	2C
IMPERIAL CHEMICAL INDUSTRIES LTD., LONDON (ENGLAND). Chemical Aspects of Some Waste Disposal Problems, W72-01872	5D	INSTITUTE OF MEDICAL PARASITOLOGY AND TROPICAL MEDICINE, MOSCOW (USSR). Contamination with Helminth Eggs of Agricultural Products from Sewage-Irrigated Fields, (In Russian), W72-01890	5B	IOWA UNIV., IOWA CITY. WATER RESOURCES RESEARCH INST. Determining the Demand and Economic Value for the Water-Based Outdoor Recreation Resources at Lake MacBride State Park in the Summer of 1970, W72-01980	6D
IMPERIAL SMELTING CORP. LTD., AVONMOUTH (ENGLAND). Wastewater Treatment and Re-Use of Treated Sewage as an Industrial Water Supply, W72-01860	5D	INSTITUTE OF WATER ENGINEERING AND LAND IMPROVEMENT, SOFIA (BULGARIA). Comparative Testing of Irrigated Local and Introduced Double Maize Hybrids (In Bulgarian), W72-01965	3F	ITT RESEARCH INST., CHICAGO, ILL. TECHNOLOGY CENTER. Development of Phosphate-Free Home Laundry Detergents, W72-01986	5B
INDIAN AGRICULTURAL RESEARCH INST., NEW DELHI. Genetic Destruction of Yield Barriers in Cereals, W72-02175	3F	INSTITUTE OF WATER ENGINEERING AND LAND IMPROVEMENT, SOFIA (BULGARIA). Comparative Evaluation of the Importance of Individual Measures in the Total Agrotechnical Complex of Maize Irrigation (In Bulgarian), W72-01966	3F	JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA, INDORE (INDIA). COLL. OF AGRICULTURE. Yield of Cotton in Relation to Rainfall in Madhya Pradesh, W72-02161	3F
INDIAN AGRICULTURAL RESEARCH INST., RANCHI (INDIA). Interculture in Transplanted Rice (<i>Oryza Sativa L.</i>), W72-02171	3F	INSTITUTO ANTARTICO ARGENTINO, BUENOS AIRES. Trophic Chains Observed in the Bay of Port Paradise (Palmer Peninsula, Antarctica) in Relation to the Variations of the Fertility of its Waters, (In Spanish), W72-01935	2L	JOHNS HOPKINS UNIV., BALTIMORE, MD. CHESAPEAKE BAY INST. A Biaxial Propeller Current-Meter System for Fixed-Mount Applications, W72-02038	7B
INDIAN GOVERNMENT RESEARCH FARM, KANPUR. Influence of Soil Moisture on Growth, Yield and Quality of Groundnut, W72-01962	3F	INSTITUTUL DE CERCETARI PENTRU CEREALE SI PLANTE TEHNICE, FUNDULEA (RUMANIA). Calibration of the 'Electronic T sub 1' Humidometer for Cereals: Pulses and Oleaginous Seeds, (In Rumanian), W72-02164	3F	JOHNS HOPKINS UNIV., BALTIMORE, MD. DEPT. OF EARTH AND PLANETARY SCIENCES. Measurement of a Three-Dimensional Field of Water Velocities at a Depth of One Meter in an Estuary, W72-02015	2L
INDIAN INST. OF SCIENCE, BANGALORE. DEPT. OF CIVIL AND HYDRAULIC ENGINEERING. Linear Proportional Weirs with Trapezoidal Bottoms, W72-01728	8B	INSTITUT CENTRAL DE RECHERCHES SUR LES PECHES INTERIEURES, BARRACKPORE (INDIA). Problems of Industrial Residual Waters in the Hooghly Estuary Zone (India), concretely the Ones From Paper Pulp and Hydrogenated Vegetable Oil Industries (Problemes d'Eaux Residuaires Industrielles Dans La Zone Du Hooghly Estuary (Inde), Notament Des Fabriques de Pate a Papier et d'Huile Vegetale Hydrogenee), W72-02208	5B	KANSAS STATE UNIV., MANHATTAN. WATER RESOURCES RESEARCH INST. Biological Treatment of Beef Animal Wastes, W72-01777	5D
INDUSTRIAL SCIENCE AND TECHNOLOGY AGENCY, KAWASAKI (JAPAN) GEOLOGICAL SURVEY. Bottom Diatoms in the Miho Bay and Its Neighboring Area on Southwestern Part of the Japan Sea, 10Yasuyo Noguchi. W72-01927	2L	INSTYTUT MELIORACJI I UZYTOKW ZIELONYCH, KRACKOW (POLAND). ZAKLAD PRZYROD. PODSTAW MELIORACJI. Effect of Different Degrees of Soil Moisture Upon Growth Yields and Floristic Changes of the Common Matgrass (<i>Nardus Stricta L.</i>) Community (In Polish), W72-01972	2G	KARLOVA UNIVERSITA, PRAGUE (CZECHOSLOVAKIA). DEPT. OF BOTANY. On the Question of the Pollination by Rain (Ombrogamy), W72-02184	2I
INSTITUT GIDRODINAMIKI, NOVOSIBIRSK (USSR). Complex-Use Management of Water Resources of the Ob River Basin (Kompleksnoye osvoeniye vodnykh resursov Okskogo basseyna). W72-02061	4A	INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION, LOGAN, UTAH. Distribution of Plant Communities in Southeastern Montana Badlands, W72-01930	2I	KARLOVA UNIVERSITA, PRAGUE (CZECHOSLOVAKIA). DEPT. OF MATHEMATICS AND STATISTICS. Analysis of Periodicity in Hydrological Sequences, W72-02012	2A
INSTITUTE FOR SOIL FERTILITY, HAREN-GRONINGEN (NETHERLANDS). Promotion of the Degree of Reduction in Soil by Flooding, W72-01968	2G	INTERNATIONAL PAPER CO., TICONDEROGA, N.Y. Effects of Light Intensity and Osmotic Stress on the Water Relations of <i>Populus Tremuloides</i> ,		KENTUCKY STATE DEPT. OF FISH AND WILDLIFE RESOURCES, FRANKFORT. The Effects of Acid Mine Pollution on the Fish Population of Goose Creek, Clay County, Kentucky, W72-01806	5C
INSTITUTE OF FRESHWATER RESEARCH, DROTTNINGHOLM (SWEDEN). Ecological Interaction of Brown Trout, <i>Salmo Trutta L.</i> , and Brook Trout, <i>Salvelinus Fontinalis</i> (Mitchill), in a Stream,				KENTUCKY UNIV., LEXINGTON, DEPT. OF CIVIL ENGINEERING. Hydraulic Jump Assisted by Cross-Jet, W72-02020	8B
				KIEL UNIV. (WEST GERMANY). INSTITUT FUER MEERESKUNDE. Spatial Structure of Inertial-Period Motions in a Two-Layered Sea, Based on Observations,	

ORGANIZATIONAL INDEX

KIRIN BREWERY CO. LTD., TAKASAKI (JAPAN). RESEARCH

W72-02033	2E	W72-01730	2F	W72-01741	2B
KIRIN BREWERY CO. LTD., TAKASAKI (JAPAN). RESEARCH LAB. Arthrobacter Luteus Nov. Sp. Isolated From Brewery Sewage, W72-02182	5A	MARYLAND STATE DEPT. OF WATER RESOURCES, ANNAPOLIS. GROUNDWATER MANAGEMENT DIV. Petroleum Contamination of Ground Water in Maryland, W72-02080	5B	MICHIGAN STATE UNIV., EAST LANSING. GRADUATE SCHOOL OF BUSINESS. Winter Commerce on the Baltic: Some Implications on Opening the Great Lakes, W72-02143	6B
LABORATOIRE INTERCOMMUNAL DE CHIMIE ET DE BACTERIOLOGIE, BRUSSELS (BELGIUM). Contributions to the Study of Bacteria in the Marine Water Off the Belgian Coast, W72-01908	5B	MASSACHUSETTS INST. OF TECH., CAMBRIDGE. Continuous Washing of Brine from Ice, W72-01832	3A	MICHIGAN STATE UNIV., EAST LANSING. KELLOGG BIOLOGICAL STATION. Predicting Variations in Energy Flow Through a Semi-Controlled Lotic Ecosystem, W72-01701	2I
LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, N.Y. Dispersal Patterns of Clay Minerals in the Sediments of the Eastern Mediterranean Sea, W72-01999	2J	MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF EARTH AND PLANETARY SCIENCES. Pacific Bottom Water: Penetration East Around Hawaii, W72-02040	2E	MICHIGAN STATE UNIV., HICKORY CORNERS. W. K. KELLOGG BIOLOGICAL STATION. Phytoplankton Nitrogen as an Index of Cultural Eutrophication, W72-01780	5C
LANDESSTELLE GEWAESSERKUNDE, BADEN-WUERTTEMBERG (WEST GERMANY). The Distribution of Species of the Genus Rivulogammarus in Flows of Northern Baden and Southern Wurttemberg, W72-01952	2I	MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF METEOROLOGY. Observations on Short-Period Internal Waves in Massachusetts Bay, W72-02035	2L	An Experimental Approach to the Production Dynamics and Structure of Freshwater Animal Communities, W72-02192	2I
LAURENTIAN UNIV., SUDBURY (ONTARIO). DEPT. OF BIOLOGY. A Hydrostatic Lysimeter to Measure Evapotranspiration Under Remote Field Conditions, W72-02187	2D	MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF SANITARY ENGINEERING. Protozoa and Activated Sludge, W72-01817	5D	MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING. Validation of Political Simulation Models - Water Resource Projects, W72-02129	6A
LENINGRAD STATE INST. FOR THE DESIGN AND PLANNING OF WATER MANAGEMENT (USSR). Problems in the Irrigation of the Kulunda Steppe (Nekotorye voprosy orosheniya Kulundinskoy stepi), W72-02101	3F	MASSACHUSETTS UNIV., AMHERST. DEPT. OF CIVIL ENGINEERING. Control of Benthic Deposits in Lakes, W72-01699	2H	MICHIGAN UNIV., ANN ARBOR. SCHOOL OF PUBLIC HEALTH. Chemical Composition of Algae and its Relationship to Taste and Odor, W72-01812	5A
LENINGRAD STATE UNIV. (USSR). A Tentative Classification of Meadows in the Floodplains of the Msta River (In Russian), W72-01976	6F	MASSACHUSETTS UNIV., AMHERST. DEPT. OF CIVIL ENGINEERING. Hydrologic Factors in the Determination of Watershed Yields, W72-01700	2A	MICHIGAN WATER RESOURCES COMMISSION, LANSING. Mercury Pollution: Michigan's Action Program, W72-01995	5B
LOS ANGELES DEPT. OF WATER AND POWER, CALIF. Gasoline Pollution of a Ground-Water Reservoir - A Case History, W72-02079	5B	MASSACHUSETTS UNIV., AMHERST. INST. OF AGRICULTURAL AND INDUSTRIAL MICROBIOLOGY. The Response of a Specialized Aquatic Ecosystem, The Duckweed Rhizosphere, to Selected Environmental Influences, W72-02114	5C	MINISTRY OF AGRICULTURE AND FORESTRY, JAPAN (TOKYO). SERICULTURAL EXPERIMENT STATION. Studies on the Irrigation in Mulberry Field: I. On the Water Economy of Mulberry Plants Under Different Soil Moisture Conditions (In Japanese), W72-01895	3F
MAGUIRE (CHARLES A.) AND ASSOCIATES, INC., WALTHAM, MASS. A Rational Evaluation of Instrumentation and Control Systems, W72-01823	5D	MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF PHYSICS; MCGILL UNIV., MONTREAL (QUEBEC). ICE RESEARCH PROJECT. Albedo of Melting Sea Ice in the Southern Beaufort Sea, W72-01711	2C	MINISTRY OF AGRICULTURE AND FORESTRY, KONOSU (JAPAN). CENTRAL AGRICULTURAL EXPERIMENT STATION. Ecological Study of Irrigation Method of Rice Plant, Influence of Underground Water Level and Rainfall in Rice Growing Season on the Growth of Rice Plant, (In Japanese), W72-02169	3F
MAINE UNIV., ORONO. DEPT. OF CIVIL ENGINEERING. Virus Removal by Coagulation with Polyelectrolytes, W72-01886	5F	MEMORIAL UNIV. OF NEWFOUNDLAND, ST. JOHN'S. DEPT. OF BIOLOGY. Evaluation of a Kicking Technique for Sampling Stream Bottom Fauna, W72-02194	2I	MINISTRY OF NATURAL RESOURCES, SOKOTO (NIGERIA). Height of Sand Dunes in Open Channel Flows, W72-02021	2J
MARINE BIOLOGICAL STATION, TORMSO (NORWAY). The Ecosystem of the Arctic Lake Nordlaguna, Jan Mayen Island: II. Plankton and Benthos, W72-02190	2H	MENASHA ELECTRIC AND WATER UTILITIES, WIS. Pre-Treatment Basin for Algae Removal, W72-01814	5F	MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF BOTANY. The Diversity of Pigments in Lake Sediments and Its Ecological Significance, W72-01784	5C
MARYLAND GEOLOGICAL SURVEY, BALTIMORE. Transmissivity Tracts in the Coastal Plain Aquifers of Maryland,		METEOROLOGICAL RESEARCH INST. TOKYO (JAPAN). Year-To-Year Variations of Rainfall Over the India-Equatorial Pacific Region and of Low and Middle Latitude Circulations in the Southern Hemisphere,		MINNESOTA UNIV., MINNEAPOLIS. LIMNOLOGICAL RESEARCH CENTER. Biological Assays and Water Quality in Minnesota,	

ORGANIZATIONAL INDEX

NEW MEXICO STATE ENGINEER OFFICE, ALBURQUERQUE.

W72-01783	5C	W72-02022	2H	W72-02014	7B
MINNESOTA UNIV. WATER RESOURCES RESEARCH CENTER. A Practical Evaluation of the Clarke-Bumpus Plankton Sampler and Suggestions for its Use, W72-01735	5C	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, GREENBELT, MD. GODDARD SPACE FLIGHT CENTER. The Anacostia River, Ecological Imbalance of an Urban Stream Valley, W72-02093	5C	NAVAL UNDERWATER SYSTEMS CENTER, NEWPORT, R. I. A Stable Spar-Buoy Platform for Mounting Instrumentation, W72-02039	7B
MISSISSIPPI STATE UNIV., STATE COLLEGE. A Unirom Flow Formula for Flumes and Canals, W72-02051	8B	Thermodynamics of Environmental Degradation, W72-02137	5G	NAVAL WEAPONS CENTER, CHINA LAKE, CALIF. Complexes of Silver Iodide and Secondary Amines, W72-02072	3B
MISSOURI UNIV., COLUMBIA. DEPT. OF AGRONOMY. Effects of Recent and Past Phosphate Fertilization on the Amount of Phosphorus Percolating Through Soil Profiles into Subsurface Waters, W72-01691	2G	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, HUNTSVILLE, ALA. MARSHALL SPACE FLIGHT CENTER. The Genesis of Sudden Stratospheric Warmings and the Quasi-Biennial Cycles, W72-02023	2B	NEBRASKA UNIV., LINCOLN. DEPT. OF CIVIL ENGINEERING. Effect of Sulfate and Other Ions in Coagulation with Aluminum, W72-01869	5D
MISSOURI UNIV., COLUMBIA. DEPT. OF CHEMISTRY. Potentiometric Techniques for Monitoring Ions Involved in Water Pollution, W72-01693	5A	NATIONAL COUNCIL FOR STREAM IMPROVEMENT, BALTIMORE, MD. Measurement, Control and Changes in Foaming Characteristics of Pulping Wastes During Biological Treatment, W72-01877	5D	NEBRASKA UNIV., LINCOLN. DEPT. OF HORTICULTURE AND FORESTRY. Energy Balance and Spectral Properties of a ReflectORIZED Soybean Canopy, W72-01747	3F
MISSOURI UNIV., ROLLA. DEPT. OF CIVIL ENGINEERING. Sorption and Desorption of Chlorinated Hydrocarbon Pesticides in Aquatic Sediment Minerals, W72-01779	5B	NATIONAL ENVIRONMENTAL SATELLITE SERVICE, WASHINGTON, D. C. Detection of Thawing Snow and Ice Packs Through the Combined use of Visible and Near-Infrared Measurements from Earth Satellites, W72-02016	7B	Lysimetric and Energy Balance Determination of Slatfence and Tree Windbreak Effects on Water Use Efficiency, W72-01748	2D
MISSOURI UNIV., ROLLA. WATER RESOURCES RESEARCH CENTER. Water Geochemistry of Mining and Milling Retention in the 'New Lead Belt' of Southeast Missouri, W72-01692	5B	NATIONAL INST. OF SCIENTIFIC RESEARCH, QUEBEC. New Approach to Hydrologic Data Acquisition, W72-02018	7A	NEVADA UNIV., RENO. CENTER FOR WATER RESOURCES RESEARCH. Multi-Site Streamflow Simulation of Truckee River, Nevada, W72-01778	2E
MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF ZOOLOGY. Further Studies on Some Saline Lakes of Southeast Australia, W72-02191	2H	NATIONAL MARINE FISHERIES SERVICE, LA JOLLA, CALIF. FISHERY-OCEANOGRAPHY CENTER. On Potential Density in the Deep South Atlantic Ocean, W72-02037	2E	NEW HAMPSHIRE STATE DEPT. OF HEALTH, CONCORD. Water-Borne Typhoid Epidemic at Keene, New Hampshire, W72-01810	5C
MONTANA STATE UNIV., BOZEMAN. DEPT. OF ECONOMICS AND AGRICULTURAL ECONOMICS. Irrigation Planning 2: Choosing Optimal Acreages Within a Season, W72-02130	6A	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER, COLO. EXPERIMENTAL METEOROLOGY LAB. Outline of a Bayesian Approach to the EML Multiple Cloud Seeding Experiments, W72-02058	3B	NEW JERSEY AGRICULTURAL EXPERIMENT STATION, NEW BRUNSWICK. Effect of Sunlight and Green Organisms on Re-Aeration of Streams, W72-01794	5C
MONTANA UNIV., MISSOULA, AND FOREST SERVICE, BERKELEY, CALIF. Some Geographic Implications of Water-Repellent Soils, W72-01745	2G	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, SALT LAKE CITY, UTAH. NATIONAL WEATHER SERVICE. Estimated Return Periods for Short-Duration Precipitation in Utah, W72-02026	2B	Transformations of Iron by Bacteria in Water, W72-01811	2K
MOSCOW STATE UNIV. (USSR). A Statistical Theory of Water Level Fluctuations in Undrained Bodies of Water (O statisticheskoy teorii kolebaniy urovney vody v besstochnykh vodovzemakh), W72-02097	2H	NATURE CONSERVANCY, EDINBURGH (SCOTLAND). The Growth of Brown Trout Salmo Trutta L. in Northern Scottish Lochs with Special Reference to the Improvement of Fisheries, W72-01915	2H	NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES; AND NEW MEXICO INST. OF MINING AND TECHNOLOGY, SOCORRO. A Survey of Saline Ground Water as a Mineral Resource, W72-01754	2K
MUSEUM OF NORTHERN ARIZONA, FLAGSTAFF. Physiographic Limitations upon the Use of Southwestern Rivers, W72-02235	6B	NAVAL RESEARCH LAB., WASHINGTON, D.C. Some Aspects of the Geochemistry of F, Fe and Mn in Coastal Waters and in Fresh-Water Springs on the Southeast Coast of Hawaii, W72-01998	2K	NEW MEXICO HIGHLANDS UNIV., LAS VEGAS. DEPT. OF CHEMISTRY. Long Term Movement of Water and Soil Salinity in the Weathering Zone of Arid Zone Sediments, W72-01753	2G
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OHIO. LEWIS RESEARCH CENTER. Analytical Solution for the Wind-Driven Circulation in a Lake Containing an Island,		NAVAL RESEARCH LAB., WASHINGTON, D.C. Ocean Spectra for the High-Frequency Waves as Determined from Airborne Radar Measurements,		NEW MEXICO STATE BUREAU OF MINES AND MINERAL RESOURCES; AND WYOMING STATE ENGINEER'S OFFICE, CHEYENNE. Geothermics in North America: Present and Future, W72-01756	4B
				NEW MEXICO STATE ENGINEER OFFICE, ALBURQUERQUE. Change of Chloride Content of Water in Response to Pumping in the Artesian Aquifer in the Roswell-East Grant Plains Area, Chaves County, New Mexico,	

ORGANIZATIONAL INDEX

NEWCASTLE AND GATESHEAD WATER CO.

W72-01751	4B	uvlahneniya na yugo-vostoke Zapadno-Sibirskoy ravniny), W72-02100	2B	W72-01864	5C
NEWCASTLE AND GATESHEAD WATER CO., NEWCASTLE-UPON-TYNE (ENGLAND).		NOVOSIBIRSK TERRITORIAL GEOLOGICAL ADMINISTRATION (USSR).		OREGON STATE UNIV., CORVALLIS. DEPT. OF CIVIL ENGINEERING.	
Determining Chlorine Dioxide and Chlorite, W72-01873	5F	Prospects of Utilizing Groundwater of the Southeastern Part of West Siberia (Perspektiv ispol'zovaniya podzemnykh vod yugo- vostochnoy chasti Zapadnoy Sibiri), W72-02102	4B	Finite-Difference Convection Errors, W72-01858	7C
NIJMEGEN UNIV. (NETHERLANDS). BOTANY LAB.		OAK RIDGE NATIONAL LAB., TENN.		OREGON STATE UNIV., CORVALLIS. DEPT. OF OCEANOGRAPHY.	
Some Data on the Growing Site of Hypericum Canadense L. (In Dutch), W72-01926	2I	Stabilization of Product Water From Seawater Distillation Plants, W72-01835	3A	Temperature and Conductivity Measurements Under Ice Island T-3, W72-02042	2K
NORTH AMERICAN ROCKWELL, CANOGA PARK, CALIF.		OFFICE DE LA RECHERCHE SCIENTIFIQUE ET TECHNIQUE OUTRE-MER, ABIDJAN (IVORY COAST). CENTRE D'ADIPODOUME.		The Origin of Metal-Bearing Submarine Hydrothermal Solutions, W72-02044	2K
The Influence of Model Membrane Systems on the Structure of Water, W72-02109	3A	Plant Parasitic Nematodes of Flooded Rice Fields on the Ivory Coast: II. Attempt at Estimating the Size of Populations (In French), W72-01951	3F	OTTAWA UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.	
NORTH CAROLINA STATE UNIV., RALEIGH. DEPT. OF CIVIL ENGINEERING.		OFFICE OF SALINE WATER, ROSWELL, N. MEX. ROSWELL TEST FACILITY.		Spectral Density of a River Flow Time Series, W72-02010	2E
Overpumped Artesian Wells Among a Well Group, W72-02005	4B	New Water Through Desalting, W72-01749	3A	PAHLAVI UNIV., SHIRAZ (IRAN). DEPT. OF CROP SCIENCE.	
NORTH CAROLINA UNIV., ASHVILLE. DEPT. OF BIOLOGY.		OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER, WOOSTER.		Rapid Field Measurement of Leaf Water Potential in Soybean, W72-02177	3F
Populations Fluctuations in the Genus Trachelomonas (Order Euglenida), W72-02189	2I	Snow in Ohio, W72-02027	2C	PELTO OIL CO., NEW ORLEANS, LA.	
NORTH CAROLINA UNIV., RALEIGH. DEPT. OF BOTANY.		OHIO STATE DEPT. OF HEALTH, COLUMBUS.		Grand Isle: A Barrier Island in the Gulf of Mexico, W72-01718	2J
Floristic and Vegetational Survey of the Chattooga River Gorge, W72-01932	2I	Water Pollution, Its Effect on Public Health, W72-01808	5C	PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.	
NORTH CAROLINA WILDLIFE RESOURCES COMMISSION, HOFFMAN.		OHIO STATE UNIV., COLUMBUS. DISASTER RESEARCH CENTER.		Thermodynamic Properties of Water to 1,000C and 10,000 Bars, W72-02048	1A
Effect of Siltation, Resulting from Improper Logging, on the Bottom Fauna of a Small Trout Stream in the Southern Appalachians, W72-01802	5C	Environment Crises, W72-01694	6B	PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF GEOSCIENCES.	
NORTHEASTERN UNIV., BOSTON, MASS. DEPT. OF CHEMISTRY.		OKLAHOMA STATE UNIV., STILLWATER.		Ground-Water Pollution Potential of a Landfill above the Water Table, W72-02081	5B
Colloid Flotation and Adsorbing Colloid Flotation, W72-02105	5D	Mechanism and Kinetics of Substrate Utilization at High Biological Solids Concentrations, W72-01843	5D	PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. MINERAL CONSERVATION SECTION.	
NORTHERN ILLINOIS UNIV., DEKALB. DEPT. OF GEOLOGY.		OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF CIVIL ENGINEERING.		Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks in Central Pennsylvania, W72-02115	4B
Permafrost-Hydrogeologic Regimen in Two Ice-Free Valleys, Antarctica, from Electrical Depth Soundings, W72-02030	2C	Optimization in Municipal Water Supply System Design, W72-02125	6A	PHILADELPHIA WATER DEPT., PA.; AND GENERAL ELECTRIC CO., PHILADELPHIA, PA.	
NORTHWESTERN UNIV., EVANSTON, ILL. Removal of Orthophosphates From Aqueous Solutions with Activated Alumina, W72-01847	5D	OKLAHOMA UNIV., NORMAN.		Toward Computer Control of Wastewater Treatment, W72-01824	5D
Coagulation of Activated Carbon Suspensions, W72-01862	5E	Solute Properties of Water--Part II, W72-02110	1A	PLANNING RESEARCH CORP., WASHINGTON, D. C.	
NORTHWESTERN UNIV., EVANSTON, ILL. MATERIALS RESEARCH CENTER.		OMSKII SELSKOKHOZYAISTVENNYI INSTITUT (USSR).		A System Analysis of Applications of Earth Orbital Space Technology to Selected Cases in Water Management and Agriculture-Volume 1, Technical Summary, W72-02029	7B
Shear Stress at the Base of a Rigidly Cirque Glacier, W72-01707	2C	Natural Moisture Conditions of the Ob Basin and Prospects of Water Development (Yestestvennyye usloviya uvlahneniya territoriy Okskogo basseynya i perspektiv gidromelioratsii), W72-02063	4A	POLISH ACADEMY OF SCIENCES, WARSAW. INST. OF ECOLOGY.	
NOVOSIBIRSK PEDAGOGICAL INST. (USSR). Complex-Use Management of the Karasuk- Burla Lakes (Kompleksnoye khozyaystvennoye ispol'zovaniye Karasuksko- Burlinskikh ozer), W72-02069	4A	ORANGE COUNTY WATER DISTRICT, SANTA ANNA, CALIF.		The Effect of Sampling Frequency and the Method of Assessment on the Production Values Obtained for Several Zooplankton Species, W72-01933	2I
Characteristics of Atmospheric Precipitation in the Southeastern Part of the West Siberian Plain (Nekotoryye osobennosti atmosfernogo		Reevaluation of Prado Water Quality Objectives, W72-01850	5G	PRAHA DA ALEGRIA, LISBON (PORTUGAL).	
		Dissolved Oxygen Variations in Stratified Lakes,		Effect of Urbanization on Storm Water Peak Flows,	

ORGANIZATIONAL INDEX

SOUTHWESTERN MISSION RESEARCH CENTER, TUCSON, ARIZ.

W72-01857	4C	W72-02084	5B	W72-02034	2E
PROVINCIAL FISH INST., LYDENBURG (SOUTH AFRICA). Ecology of the Tiger-Fish (Hydrocynus Vittatus) in the Incomati River System, South Africa, W72-0185	8I	ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO. Stream Life and the Pollution Environment, W72-01803	5C	SHEFFIELD UNIV. (ENGLAND). DEPT. OF BOTANY. Vegetation of the Olokemeji Forest Reserve, Nigeria: VII. The Plants on the Savanna Site with Special Reference to Their Seasonal Growth, W72-01924	21
PUBLIC HEALTH SERVICE, CINCINNATI, OHIO. Sewage, Algae and Fish, W72-01788	5C	ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO; AND SOUTH DAKOTA STATE COLL., BROOKINGS. DEPT. OF ZOOLOGY. Biological Factors in Treatment of Raw Sewage in Artificial Ponds, W72-01818	5D	SHEFFIELD UNIV., (ENGLAND). DEPT. OF CIVIL ENGINEERING. An Extended Theory of Delayed Yield from Storage Applied to Pumping Tests in Unconfined Anisotropic Aquifers, W72-02011	4B
PUBLIC HEALTH SERVICE, CINCINNATI, OHIO; AND OREGON STATE COLL., CORVALLIS. DEPT. OF FISH AND GAME MANAGEMENT. Biological Indices of Water Pollution with Special Reference to Fish Population, W72-01791	5C	ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO. INTERFERENCE ORGANISMS STUDIES AND WATER SUPPLY AND WATER POLLUTION CONTROL RESEARCH. Suggested Classification of Algae and Protozoa in Sanitary Science, W72-01798	5C	SIR THEAGARAYA COLL., MADRAS (INDIA). DEPT. OF ZOOLOGY. Influence of Activity and Salinity on the Weight-Dependent Oxygen Consumption of the Rainbow Trout <i>Salmo Gairdneri</i> , W72-01914	21
PUBLIC HEALTH SERVICE, CINCINNATI, OHIO. BIOLOGY SECTION. The Effects of Sewage Pollution on the Fish Population of a Midwestern Stream, W72-01805	5C	ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO. WATER SUPPLY AND WATER POLLUTION PROGRAM. Potential Plant Pathogenic Fungi in Sewage and Polluted Water, W72-01809	5C	SKIDAWAY INST. OF OCEANOGRAPHY, SAVANNAH, GA. Diurnal Variations in the Chemical Characteristics of the Ogeechee Estuary in Georgia, W72-01934	2L
PUBLIC HEALTH SERVICE, CINCINNATI, OHIO. ENVIRONMENTAL HEALTH CENTER. Some Important Biological Effects of Pollution Often Disregarded in Stream Surveys, W72-01790	5C	ROBERT S. KERR WATER RESEARCH CENTER, ADA, OKLA. Agricultural Utilization of Sewage Effluent and Sludge, an Annotated Bibliography, W72-02104	5G	SOUTH CAROLINA STATE PLANNING AND GRANTS DIV., COLUMBIA. COMMUNITY AFFAIRS SECTION. Water Quality Management Planning in South Carolina: A Planning Manual, W72-01825	6D
PUBLIC HEALTH SERVICE, CINCINNATI, OHIO. STREAM POLLUTION INVESTIGATIONS. Aquatic Life in Waters Polluted by Acid Mine Waste, W72-01796	5C	ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION, FORT COLLINS, COLO. Climatological Influences on Moisture Characteristics of Dead Fuel: Theoretical Analysis, W72-01910	2B	SOUTH PIEDMONT CONSERVATION RESEARCH CENTER, WATKINSVILLE, GA. Pesticide contamination of a Shallow Bored Well in the Southeastern Coastal Plains, W72-02078	5B
PUBLIC HEALTH SERVICE, WASHINGTON, D. C. Water Quality Requirements for Recreational Uses, W72-01807	5G	RUTGERS-THE STATE UNIV., NEW BRUNSWICK, N. J. Aerator Performance in Natural Streams, W72-01842	5G	SOUTHEASTERN MASSACHUSETTS TECHNOLOGICAL UNIV., NORTH DARTMOUTH. Oxygen Requirements of Some Marine and Anadromous Fishes, with Particular Reference to Problems of Measurement, W72-01875	5C
Kinetics of the Steady State Bacterial Culture IV. Transfer Rates, W72-01865	5D	RUTGERS-THE STATE UNIV., NEW BRUNSWICK, N. J. DEPT. OF METEOROLOGY. Investigation of the Effects of Urbanization on Precipitation Type, Frequency, Areal and Temporal Distribution, W72-01982	2B	SOUTHERN ILLINOIS UNIV., CARBONDALE. DEPT. OF GEOLOGY. Heavy Minerals of Northern Sand Key, Pinellas County, Florida, W72-01732	2J
QUEEN'S UNIV., BELFAST (IRELAND). DEPT. OF GEOGRAPHY. A Method of Monitoring Mudflow Movements, W72-01722	2J	RUTGERS-THE STATE UNIV., NEW BRUNSWICK, N. J. WATER RESOURCES RESEARCH INST. 1970 Literature Review, Administration: Economics, W72-02140	6B	SOUTHERN RESEARCH INST., BIRMINGHAM, ALA. Field Evaluation of Forced-Flow Electrodesalination, W72-01836	3A
QUEENSLAND UNIV., BRISBANE (AUSTRALIA). DEPT. OF AGRICULTURE. Some Factors Responsible for Varying Effectiveness of Stomatal Closing Antitranspirants, W72-01774	3F	SASKATCHEWAN-NELSON BASIN BOARD, REGINA. Multireservoir Analysis Techniques in Water Quantity Studies, W72-02057	4A	SOUTHWEST WATERSHED RESEARCH CENTER, TUCSON, ARIZ. Some Regional Differences in Runoff-Producing Thunderstorm Rainfall in the Southwest, W72-02214	2B
RESEARCH COUNCIL OF ALBERTA, EDMONTON. An Algorithm for Least Squares Analysis of Drawdown in Observation Wells, W72-02008	4B	SCRIPPS INSTITUTION OF OCEANOGRAPHY, LAJOLLA, CALIF. INTER-AMERICAN TROPICAL TUNA COMMISSION. New Evidence of the Equatorial Undercurrent East of the Galapagos Islands,		SOUTHWESTERN MISSION RESEARCH CENTER, TUCSON, ARIZ. Use and Abuse of Southwestern Rivers. Historic Man--The Spaniard,	
RESEARCH TRIANGLE INST., RESEARCH TRIANGLE PARK, N.C. Improved Membranes for Reverse Osmosis, W72-01833	3A				
RHODE ISLAND UNIV., KINGSTON. NARRAGANSETT MARINE LAB. Cesium-137 in the North Atlantic Measured by Selective Absorption in Situ,					

ORGANIZATIONAL INDEX

STAATLICHES INSTITUT RHEUMA UND

W72-02237	4A	W72-01695	1A	W72-02055
STAATLICHES INSTITUT RHEUMA UND BAEDERWESEN, BUDAPEST, (HUNGARY). Dynamic Orientation of Medical Climatology, W72-01945	2B	TETRA TECH. INC., PASADENA, CALIF. Transient Motions induced by Local Disturbances in a Linearly Density-Stratified Fluid, W72-01726	2E	UDAIPUR UNIV. (INDIA). AGRICULTURAL EXPERIMENT STATION. Quality of Irrigation Waters of Kanjhawala and Alipur Blocks of Delhi in Relation to Soil Properties and Growth of Wheat, W72-01964
STANFORD RESEARCH INST., IRVINE, CALIF. In-Situ Regenerable Membranes for Reverse Osmosis, W72-01837	3A	TEXAS A AND M UNIV., COLLEGE STATION. Sulfuric Acid Attack on Concrete Sewer Pipe, W72-01848	8F	UNION ALLUMETTIRE, OVERBOELAR (BELGIUM). Biological Treatment of Strong Industrial Waste from a Fiberboard Factory, W72-01885
STANFORD UNIV., CALIF. Aerobic Decomposition of Algae, W72-01881	5D	TEXAS A AND M UNIV., COLLEGE STATION. Drag Forces on Baffle Blocks in Hydraulic Jumps, W72-02019	8B	UNIVERSAL WATER CORP., DEL MAR, CALIF. Reverse Osmosis Pilot Plant for Desalination of Sea Water, W72-01831
The Simulation and Optimization of a Single Effect Multi-Stage Flash Desalination Plant, W72-02131	6A	TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF AGRICULTURAL ENGINEERING. Dynamic Simulation of Vertical Infiltration into Unsaturated Soils, W72-01782	2G	UNIVERSITY OF MANCHESTER INST. OF SCIENCE AND TECHNOLOGY (ENGLAND). Effect of Filter Cloth Structure on Flow Resistance, Bleeding, Blinding and Plant Performance, W72-01878
STATE BOARD OF HEALTH, MADISON, WIS. The Chemistry and Biology of Milk Waste Disposal, W72-01816	5D	TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF SOIL AND CROP SCIENCE. Energy and CO ₂ Balance of an Irrigated Sugar Beet (Beta Vulgaris) Field in the Great Plains, W72-02178	3F	UPPER TAME MAIN DRAINAGE AUTHORITY, BIRMINGHAM (ENGLAND). Insect Populations of Sludge-Drying Beds, W72-01863
STATE OCEANOGRAPHIC INST., MOSCOW (USSR). Hydrologic Computational Methods for Marine Hydraulic Engineering Construction (Metody morskikh gidrologicheskikh raschetov dlya tseley gidrotekhnicheskogo stroitel'stva), W72-02094	2L	TEXAS TECH UNIV., LUBBOCK. DEPT. OF GEOSCIENCES. Saline Lake Basins of the Southern High Plains, W72-01752	2F	UPPSALA UNIV. (SWEDEN). INST. OF LIMNOLOGY. Limnological Studies of Lake Norrviken, A Eutrophicated Swedish Lake: II. Phytoplankton and Its Production, W72-02199
Present-day and Long-term Water and Salt Balance of Southern Seas of the USSR (Azov, Caspian and Aral) and Possible Changes in Their Hydrologic and Hydrochemical Regimes (Sovremennyyi i perspektivnyi vodnyi i solevoy balansy i vozmozhnyye izmeneniya gidrologicheskogo i gidrokhimicheskogo rezhimov yuzhnykh morey SSSR (Azovskogo, Kaspiyskogo i Aralskogo), W72-02099	2H	Saline Waters: Genesis and Relationship to Sediments and Host Rocks, W72-01755	2K	URS RESEARCH CO., SAN MATEO, CALIF.; AND WHITE (KEN R.) CO., DENVER, COLO. Improving Municipal Water Supplies in Colorado by Desalting, W72-01839
STUTTGART UNIV. (WEST GERMANY). The De-Watering of Digested Sludge Using Synthetic Filtering Agents, W72-01846	5E	Subsurface Distribution of Nitrates Below Commercial Cattle Feedlots, Texas High Plains, W72-02003	5B	UTAH STATE UNIV., FOUNDATION, LOGAN. Characteristics and Pollution Problems of Irrigation Return Flow, W72-01984
SUNFLOWER ARMY AMMUNITION PLANT, LAWRENCE, KANS. Comparison of Plant Water Quality to Proposed Water Quality Standard, W72-02082	5F	TOMSK STATE UNIV. (USSR). Formation of Spring Runoff in the Vasyugan'ye (O formirovaniyu vesennego stoka v usloviyakh Vasyugan'ya), W72-02068	4A	UTAH STATE UNIV., SALT LAKE CITY. DEPT. OF CIVIL ENGINEERING. Tidal Choking, W72-01725
SWISS FEDERAL INST. FOR SNOW AND AVALANCHE RESEARCH, DAVOS-WEISEFLUHJOCH. On the Temperature Profile and the Age Profile in the Central Part of Cold Ice Sheets, W72-01705	2C	TOTTORI UNIV. (JAPAN). FACULTY OF EDUCATION. Studies on the Aquatic Insect Community of Mountain Stream at the Foot of Mt. Daisen: I. Ecological Investigation on a Population of Ephemeroptera (In Japanese), W72-01953	2I	UTAH WATER RESEARCH LAB., LOGAN; AND ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION, ROCKVILLE, MD. Influences of Exposure on Pan Evaporation in a Mountainous Area, W72-02119
SYDNEY UNIV. (AUSTRALIA). DEPT. OF AGRONOMY. A Comparative Study of Two Methods of Applying CCC (2-Chloroethyl) Trimethylammonium Chloride to Wheat, W72-02118	3F	TROMSO MUSEUM (NORWAY). Plankton Swarms in Lake Gjokvatn, East Finnmark, W72-02193	2H	VANDERBILT UNIV., NASHVILLE, TENN.-DEPT. OF ENVIRONMENTAL AND WATER RESOURCES ENGINEERING. Predicting Effects of Dead Zones on Stream Mixing, W72-01853
TAHAL CONSULTING ENGINEERS LTD., TEL AVIV (ISRAEL). DIV. OF HYDROLOGY. Artificial Ground-Water Recharge by Means of Wells in Israel, W72-02017	4B	TUFTS UNIV., MEDFORD, MASS. DEPT. OF CIVIL ENGINEERING. Relationship Between Escherichia Coli, Type I and Enterococci in Water, W72-01854	5B	VERMONT UNIV., BURLINGTON. DEPT. OF AGRICULTURAL ENGINEERING. Drying Rates of Birdfoot Trefoil Seed, W72-02089
TENNESSEE UNIV., KNOXVILLE. DEPT. OF CHEMISTRY. Isotope Effect on the Thermodynamic Activity of Water.		A Critical Examination of Bathing Water Quality Standards, W72-01997	5B	VIRGIN ISLANDS NATIONAL PARK, ST. JOHN. Seasonal Distribution of Zooplankton in the Northern Basin of Lake Chad.

ORGANIZATIONAL INDEX

WYZSZA SZKOŁA ROLNICZA, KRAKOW (POLAND).

W72-01942	2H	W72-01740	2I	A Self-Watering System for Growing Plants in Potted Soils, W72-02166	3F
VIRGINIA HIGHWAY RESEARCH COUNCIL, CHARLOTTESVILLE.		WESTERN MICHIGAN UNIV., KALAMAZOO; AND NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, DETROIT, MICH.		WISCONSIN UNIV., MADISON. WATER CHEMISTRY LAB.	
Bedrock Weathering and Residual Soil Formation in Central Virginia, W72-01716	2J	Precipitation Probabilities as Indices of Climatic Variation over the Eastern United States, W72-02210	2B	Characterization of Inorganic Phosphate in Noncalcareous Lake Sediments, W72-02113	2H
VYSOKA SKOLA ZEMEDELSKA, BRNO (CZECHOSLOVAKIA). FAKULTA LESNICKA.		WISCONSIN DEPT. OF CONSERVATION, MADISON; AND WISCONSIN BOARD OF HEALTH, MADISON.		WISCONSIN UNIV., MADISON. WATER RESOURCES CENTER.	
Water Loss in Forest Tree Seedlings and Their Waterholding Capacity (In Czech), W72-01905	2D	A Heavy Mortality of Fishes Resulting from the Decomposition of Algae in the Yahara River, Wisconsin, W72-01797	5C	Design and Construction of a Shallow Water Sediment Core Sampler, W72-01738	5A
WASHINGTON STATE UNIV., PULLMAN. WATER RESEARCH CENTER.		WISCONSIN STATE COMMITTEE ON WATER POLLUTION, MADISON.		Water Resources Policy in Wisconsin: A Summary Assessment, Volume 1, W72-01979	6E
On the Economic Impact of Large Diversions of Snake River Waters, W72-02124	6D	Biological Aspects of Stream Pollution, W72-01789	5C	WISCONSIN UNIV., MILWAUKEE. DEPT. OF GEOLOGICAL SCIENCES.	
WASHINGTON UNIV., ST. LOUIS, MO. DEPT. OF CIVIL AND SANITARY ENGINEERING.		WISCONSIN STATE UNIV., OSKOSH. DEPT. OF BIOLOGY; AND WISCONSIN UNIV., MADISON. WATER RESOURCES CENTER.		An Improved Method for Determining Ice Fabrics, W72-02002	2C
A Study of Pineapple Cannery Waste, W72-01876	5D	Microfungi in the Water, Mud, and Litter of a Cattail Marsh, W72-02112	5C	WISCONSIN UNIV., MILWAUKEE. DEPT. OF PHYSICS.	
WATERLOOPKUNDIG LABORATORIUM, DELFT (NETHERLANDS).		WISCONSIN UNIV., MADISON.		Nonlinear Dupuit Equations for the Phreatic Surface of a Semi-Infinite Aquifer, W72-02004	2F
Discontinuities in Stratified Flows, W72-01723	2E	Oxygen Diffusion Through a Pure Culture Floc of Zoogloea Ramigera, W72-01851	5D	WOLLONGONG UNIV. COLL. (AUSTRALIA). DEPT. OF MATHEMATICS.	
WEST VIRGINIA PULP AND PAPER CO., COVINGTON.		Influence of Atmospheric and Soil Environmental Parameters on the Diurnal Fluctuations of Leaf Water Status of Barley, W72-01970	3F	Seiche Motions for a Basin of Rectangular Plan and of Nonuniform Depth, W72-02031	2E
Pilot Mechanical Aeration Studies of the Jackson River in Covington, West Virginia, W72-01845	5G	WISCONSIN UNIV., MADISON. DEPT. OF FORESTRY.		WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS.	
WEST VIRGINIA UNIV., MORGANTOWN.		Water Transport in Relation to Expansion and Contraction of Leaves and Fruits of 'Calamondin' Orange, W72-01892	2D	Plutonium-239 in and Over the Atlantic Ocean, W72-02083	5B
Climate of the Elk River Basin and Climatological Summaries for Pickens, Webster Springs, and Gassaway, West Virginia, W72-02025	2B	WISCONSIN UNIV., MADISON: DEPT. OF SOIL SCIENCE.		Analysis of Snowmelt Phenomena in 1963 and 1964 in Catchment Areas of Three Mountain Streams (In Polish), W72-02188	2C
WESTERN AUSTRALIA UNIV., NEDLANDS. DEPT. OF BOTANY.					
Ecophysiological Studies on Plants in Arid and Semiarid Regions in Western Australia. IV. Comparison of the Field Physiology of the Host, <i>Acacia</i> Grasbyi and its Hemiparasite, <i>Amyema</i> Nestor Under Optimal and Stress Conditions,					

ACCESSION NUMBER INDEX

W72-01691	2G	W72-01769	8E	W72-01848	8F	W72-01926	2I
W72-01692	5B	W72-01770	8D	W72-01849	5D	W72-01927	2L
W72-01693	5A	W72-01771	8C	W72-01850	5G	W72-01928	2I
W72-01694	6B	W72-01772	3F	W72-01851	5D	W72-01929	2K
W72-01695	1A	W72-01773	5F	W72-01852	5D	W72-01930	2I
W72-01696	4B	W72-01774	3F	W72-01853	5B	W72-01931	2B
W72-01697	5B	W72-01775	8C	W72-01854	5B	W72-01932	2I
W72-01698	4C	W72-01776	8G	W72-01855	5D	W72-01933	2I
W72-01699	2H	W72-01777	5D	W72-01856	5D	W72-01934	2L
W72-01700	2A	W72-01778	2E	W72-01857	4C	W72-01935	2L
W72-01701	2I	W72-01779	5B	W72-01858	7C	W72-01936	2H
W72-01702	2C	W72-01780	5C	W72-01859	5E	W72-01937	2H
W72-01703	2A	W72-01781	2F	W72-01860	5D	W72-01938	2H
W72-01704	2E	W72-01782	2G	W72-01861	5D	W72-01939	2I
W72-01705	2C	W72-01783	5C	W72-01862	5E	W72-01940	2I
W72-01706	2C	W72-01784	5C	W72-01863	5D	W72-01941	5B
W72-01707	2C	W72-01785	5C	W72-01864	5C	W72-01942	2H
W72-01708	2C	W72-01786	5C	W72-01865	5D	W72-01943	2C
W72-01709	2C	W72-01787	5C	W72-01866	5D	W72-01944	2G
W72-01710	2C	W72-01788	5C	W72-01867	5C	W72-01945	2B
W72-01711	2C	W72-01789	5C	W72-01868	5F	W72-01946	2D
W72-01712	2C	W72-01790	5C	W72-01869	5D	W72-01947	2B
W72-01713	2I	W72-01791	5C	W72-01870	5F	W72-01948	2H
W72-01714	2C	W72-01792	5B	W72-01871	5D	W72-01949	2I
W72-01715	2C	W72-01793	5C	W72-01872	5D	W72-01950	2I
W72-01716	2I	W72-01794	5C	W72-01873	5F	W72-01951	3F
W72-01717	2I	W72-01795	5C	W72-01874	5G	W72-01952	2I
W72-01718	2I	W72-01796	5C	W72-01875	5C	W72-01953	2I
W72-01719	2I	W72-01797	5C	W72-01876	5D	W72-01954	2L
W72-01720	2F	W72-01798	5C	W72-01877	5D	W72-01955	2I
W72-01721	2L	W72-01799	5C	W72-01878	5D	W72-01956	5C
W72-01722	2J	W72-01800	5C	W72-01879	5D	W72-01957	3F
W72-01723	2E	W72-01801	5C	W72-01880	4A	W72-01958	3C
W72-01724	2E	W72-01802	5C	W72-01881	5D	W72-01959	3F
W72-01725	2L	W72-01803	5C	W72-01882	5D	W72-01960	3F
W72-01726	2E	W72-01804	5C	W72-01883	5G	W72-01961	3F
W72-01727	2J	W72-01805	5C	W72-01884	5B	W72-01962	3F
W72-01728	8B	W72-01806	5C	W72-01885	5D	W72-01963	3F
W72-01729	8B	W72-01807	5G	W72-01886	5F	W72-01964	3C
W72-01730	2F	W72-01808	5C	W72-01887	2I	W72-01965	3F
W72-01731	2F	W72-01809	5C	W72-01888	5A	W72-01966	3F
W72-01732	2J	W72-01810	5C	W72-01889	5B	W72-01967	3F
W72-01733	2G	W72-01811	2K	W72-01890	5B	W72-01968	2G
W72-01734	2G	W72-01812	5A	W72-01891	2I	W72-01969	3F
W72-01735	5C	W72-01813	5C	W72-01892	2D	W72-01970	3F
W72-01736	3F	W72-01814	5F	W72-01893	4A	W72-01971	3F
W72-01737	3F	W72-01815	5C	W72-01894	2I	W72-01972	2G
W72-01738	5A	W72-01816	5D	W72-01895	3F	W72-01973	3F
W72-01739	3F	W72-01817	5D	W72-01896	6G	W72-01974	3F
W72-01740	2I	W72-01818	5D	W72-01897	4A	W72-01975	3F
W72-01741	2B	W72-01819	5D	W72-01898	4A	W72-01976	6F
W72-01742	3F	W72-01820	5D	W72-01899	4A	W72-01977	3F
W72-01743	4B	W72-01821	8A	W72-01900	4A	W72-01978	2A
W72-01744	2G	W72-01822	5F	W72-01901	4A	W72-01979	6E
W72-01745	2G	W72-01823	5D	W72-01902	4A	W72-01980	6D
W72-01746	6B	W72-01824	5D	W72-01903	4A	W72-01981	2K
W72-01747	3F	W72-01825	6D	W72-01904	2G	W72-01982	2B
W72-01748	2D	W72-01826	8A	W72-01905	2D	W72-01984	5B
W72-01749	3A	W72-01827	8A	W72-01906	2G	W72-01986	5B
W72-01750	2G	W72-01828	8A	W72-01907	2I	W72-01987	5C
W72-01751	4B	W72-01829	6D	W72-01908	5B	W72-01988	5C
W72-01752	2F	W72-01830	6D	W72-01909	2I	W72-01990	5B
W72-01753	2G	W72-01831	3A	W72-01910	2B	W72-01991	5B
W72-01754	2K	W72-01832	3A	W72-01911	2I	W72-01992	5B
W72-01755	2K	W72-01833	3A	W72-01912	2I	W72-01993	5A
W72-01756	4B	W72-01834	3A	W72-01913	2I	W72-01994	
W72-01757	3F	W72-01835	3A	W72-01914	2I	W72-01995	5B
W72-01758	3F	W72-01836	3A	W72-01915	2H	W72-01996	5B
W72-01759	3F	W72-01837	3A	W72-01916	2H	W72-01997	5B
W72-01760	2I	W72-01838	5E	W72-01917	8I	W72-01998	2K
W72-01761	2I	W72-01839	3A	W72-01918	2L	W72-01999	2J
W72-01762	3F	W72-01841	5D	W72-01919	2I	W72-02000	2C
W72-01763	8G	W72-01842	5G	W72-01920	2L	W72-02001	2C
W72-01764	8H	W72-01843	5D	W72-01921	2I	W72-02002	2C
W72-01765	8D	W72-01844	5D	W72-01922	2I	W72-02003	5B
W72-01766	8C	W72-01845	5G	W72-01923	2I	W72-02004	2F
W72-01767	3F	W72-01846	5E	W72-01924	2I	W72-02005	4B
W72-01768	3F	W72-01847	5D	W72-01925	2I	W72-02006	5D

ACCESSION NUMBER INDEX

W72-02007

W72-02007	2K	W72-02069	4A	W72-02130	6A	W72-02191	2H
W72-02008	4B	W72-02070	4A	W72-02131	6A	W72-02192	2I
W72-02010	2E	W72-02071	4B	W72-02132	6A	W72-02193	2H
W72-02011	4B	W72-02072	3B	W72-02133	6E	W72-02194	2I
W72-02012	2A	W72-02073	2K	W72-02134	6B	W72-02195	6E
W72-02013	2K	W72-02074	2K	W72-02135	5G	W72-02196	5A
W72-02014	7B	W72-02075	5E	W72-02136	6B	W72-02197	5C
W72-02015	2L	W72-02076	5E	W72-02137	5G	W72-02198	2H
W72-02016	7B	W72-02077	5D	W72-02138	6E	W72-02199	5C
W72-02017	4B	W72-02078	5B	W72-02139	6E	W72-02200	2L
W72-02018	7A	W72-02079	5B	W72-02140	6B	W72-02201	6E
W72-02019	8B	W72-02080	5B	W72-02141	6E	W72-02202	2I
W72-02020	8B	W72-02081	5B	W72-02142	5E	W72-02203	5A
W72-02021	2J	W72-02082	5F	W72-02143	6B	W72-02204	2L
W72-02022	2H	W72-02083	5B	W72-02144	6E	W72-02205	2L
W72-02023	2B	W72-02084	5B	W72-02145	6E	W72-02206	2I
W72-02024	5A	W72-02085	2E	W72-02146	4A	W72-02207	4A
W72-02025	2B	W72-02086	4B	W72-02147	2C	W72-02208	5B
W72-02026	2B	W72-02087	4B	W72-02148	6E	W72-02209	4A
W72-02027	2C	W72-02088	4B	W72-02149	6E	W72-02210	2B
W72-02028	6B	W72-02089	3F	W72-02150	6E	W72-02211	3F
W72-02029	7B	W72-02090	4A	W72-02151	5G	W72-02212	4A
W72-02030	2C	W72-02091	2C	W72-02152	5G	W72-02213	2E
W72-02031	2E	W72-02092	2C	W72-02153	6E	W72-02214	2B
W72-02032	2G	W72-02093	5C	W72-02154	5G	W72-02215	2F
W72-02033	2E	W72-02094	2L	W72-02155	5G	W72-02216	2K
W72-02034	2E	W72-02095	2G	W72-02156	6E	W72-02217	2D
W72-02035	2L	W72-02096	2E	W72-02157	6E	W72-02218	2G
W72-02036	5B	W72-02097	2H	W72-02158	2J	W72-02219	2G
W72-02037	2E	W72-02098	3F	W72-02159	5B	W72-02220	2G
W72-02038	7B	W72-02099	2H	W72-02160	5B	W72-02221	3F
W72-02039	7B	W72-02100	2B	W72-02161	3F	W72-02222	2G
W72-02040	2E	W72-02101	3F	W72-02162	3F	W72-02223	6A
W72-02041	2E	W72-02102	4B	W72-02163	2I	W72-02224	2E
W72-02042	2K	W72-02103	3F	W72-02164	3F	W72-02225	5A
W72-02043	2J	W72-02104	5G	W72-02165	3F	W72-02226	5D
W72-02044	2K	W72-02105	5D	W72-02166	3F	W72-02227	4B
W72-02045	3A	W72-02106	2J	W72-02167	3F	W72-02228	5G
W72-02046	3A	W72-02107	3A	W72-02168	3F	W72-02229	2F
W72-02047	3A	W72-02108	3A	W72-02169	3F	W72-02230	4A
W72-02048	1A	W72-02109	3A	W72-02170	3F	W72-02231	3F
W72-02049	3A	W72-02110	1A	W72-02171	3F	W72-02232	4B
W72-02050	5D	W72-02111	3A	W72-02172	3F	W72-02233	6C
W72-02051	8B	W72-02112	5C	W72-02173	3F	W72-02234	7B
W72-02052	2H	W72-02113	2H	W72-02174	3F	W72-02235	6B
W72-02053	2H	W72-02114	5C	W72-02175	3F	W72-02236	3F
W72-02054	2H	W72-02115	4B	W72-02176	3F	W72-02237	4A
W72-02055	2F	W72-02116	2A	W72-02177	3F	W72-02238	4A
W72-02056	2C	W72-02117	3F	W72-02178	3F	W72-02239	3F
W72-02057	4A	W72-02118	3F	W72-02179	3F	W72-02240	2G
W72-02058	3B	W72-02119	2D	W72-02180	3F	W72-02241	3F
W72-02059	2J	W72-02120	8G	W72-02181	3F	W72-02242	2D
W72-02060	8B	W72-02121	6A	W72-02182	5A	W72-02243	3F
W72-02061	4A	W72-02122	6E	W72-02183	2H	W72-02244	3F
W72-02062	4A	W72-02123	6E	W72-02184	2I	W72-02245	3F
W72-02063	4A	W72-02124	6D	W72-02185	8I	W72-02246	2I
W72-02064	4A	W72-02125	6A	W72-02186	6E	W72-02247	2I
W72-02065	4A	W72-02126	6A	W72-02187	2D	W72-02248	2I
W72-02066	4A	W72-02127	6A	W72-02188	2C	W72-02249	2J
W72-02067	4A	W72-02128	6A	W72-02189	2I	W72-02250	6G
W72-02068	4A	W72-02129	6A	W72-02190	2H	W72-02251	5B
						W72-02252	6G

ABSTRACT SOURCES

Source	Accession Number	Total
A. Center of Competence		
University of Arizona, Arid Land Water Resources	W72-01739--01762 02207--02238	56
U.S. Geological Survey, Hydrology	W72-01698--01732 01781--01782 01988 01995--02044 02050--02103 02215--02216	144
Bureau of Reclamation, Engineering Works	W72-01763--01766 01769--01771 01773 01775--01776	10
University of Wisconsin, Eutrophication	W72-01783--01820	38
University of Texas, Wastewater Treatment and Management	W72-01840--01883 01885--01886	46
Cornell University, Policy Models for Water Resources Systems	W72-02124--02132	9
University of Wisconsin, Water Resources Economics	W72-02134--02137 02140 02142--02143 02146--02147	9
University of Florida, Eastern U.S. Water Law	W72-02122--02123 02133 02138--02139 02141 02144--02145 02148--02157 02186 02195--02196 02201	22
B. State Water Resources Research Institutes		
Missouri Water Resources Research Center	W72-01691--01693 01779	4
Ohio Water Resources Center	W72-01694	1
Tennessee Water Resources Research Center	W72-01695	1
Florida Water Resources Research Center	W72-01696--01697 01981	3
Minnesota Water Resources Research Center	W72-01735	1
Wisconsin Water Resources Center	W72-01738, 01979 02112--02114	5
Kansas Water Resources Research Institute	W72-01777	1
Nevada Center for Water Resources Research	W72-01778	1
Michigan Institute of Water Research	W72-01780	1
Iowa State Water Resources Research Institute	W72-01980	1
New Jersey Water Resources Research Institute	W72-01982	1

ABSTRACT SOURCES

Source	Accession Number	Total
C. Other		
Office of Water Resources Research	W72-01978	1
Engineering Aspects of Urban Water Resources (Poertner)	W72-01821--01830	10
Office of Saline Water	W72-01831--01839 02045--02049 02107--02111	19
BioSciences Information Service	W72-01733--01734 01736--01737 01767--01768 01772, 01774 01884 01887--01977 02117--02118 02161--02185 02187--02194 02197--02200 02202--02206 02239--02252	158
Environmental Protection Agency	W72-01983--01987 01989--01994 02104--02106 02158--02160	17
National Oceanic & Atmospheric Administration	W72-02119	1
Corps of Engineers	W72-02120--02121	2

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SECTION OF INFORMATION ON THE SUBJECT OF POLYMER

1. *General information about the term polymer. Definition of polymer.*

2. *General information about the term polymer. Definition of polymer.*

3. *General information about the term polymer. Definition of polymer.*

4. *General information about the term polymer. Definition of polymer.*

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26. *General information about the term polymer. Definition of polymer.*

27. *General information about the term polymer. Definition of polymer.*

28. *General information about the term polymer. Definition of polymer.*

CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE

- Ground and surface water hydrology at the Water Resources Division of the U. S. Geological Survey, U. S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Center of the University of Wisconsin.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the Soap and Detergent Association and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.
- Water-related aspects of nuclear radiation and safety at the Oak Ridge National Laboratory.
- Public Work Supply Treatment Technology at the American Water Works Association.

Supported by the Environmental Protection Agency in cooperation with WRSIC.

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.
- Agricultural livestock wastes at the Department of Agricultural Engineering of Iowa State University.
- Methods for chemical and biological identification and measurement of pollutants at the Analytical Quality Control Laboratory of the Environmental Protection Agency.
- Coastal pollution at the Oceanic Research Institute.
- Water treatment plant waste pollution control at American Water Works Association Research Foundation.

Subject Fields

- 1 NATURE OF WATER
- 2 WATER CYCLE
- 3 WATER SUPPLY AUGMENTATION AND CONSERVATION
- 4 WATER QUANTITY MANAGEMENT AND CONTROL
- 5 WATER QUALITY MANAGEMENT AND PROTECTION
- 6 WATER RESOURCES PLANNING
- 7 RESOURCES DATA
- 8 ENGINEERING WORKS
- 9 MANPOWER, GRANTS, AND FACILITIES
- 10 SCIENTIFIC AND TECHNICAL INFORMATION



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INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSION NUMBER INDEX
- ABSTRACT SOURCES

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